AIS Economic Analysis Handbook
Table of Contents

Introduction

Purpose

This handbook provides a step by step approach to understanding and preparing financial analysis for the life cycle management of Class VI Automated Information Systems (AIS). With today's limited budgets, financial analysis provides a tool to evaluate alternatives in a structured way to ensure that cost effective alternatives are implemented. This handbook provides the framework to prepare financial analyses to support the life cycle management of Class VI AIS as defined in ER 25-1-2.

Scope

This handbook applies to all HQUSACE/OCE staff elements, Major Subordinate Commands (MSC), Districts, Laboratories, and Field Operating Activities (FOA) having an interest in any phase of development, operation, or management of Class VI systems.

This handbook does not apply to AIS over 2.5 million dollars (Class I - V). Life cycle management requirements for Class I - V systems must comply with AR 25-3 "Army Life Cycle Management of Information Systems," dated 27 Nov 94.

Classes of Automated Systems

There are six classes of information systems categorized by program cost, shown in Figure 1-1. Program costs include all costs incurred from project initiation through full deployment of the system to each opera-

tional site. All information systems fall under one of these six classes. Associated with each of the classes are levels of approval authority and management responsibility. The approval authority, degree of management oversight, and documentation requirements differ for each class to ensure that each class receives appropriate management oversight. The requirements for each system class can be found in AR 25-3. The U.S. Army Corps of Engineers (USACE) is responsible for the approval and program management of automation resources classified as Class VI systems to include the preparation of any evaluation and implementation guidelines, program execution and internal review. In accordance with ER 25-1-2, Class VI systems further divide, based on program cost, into three additional system classes (VI(a), (b), (c)). Associated with each subdivision of the Class VI system is a corresponding required level of financial analysis to support program definition and evaluation. Table 1-1 shows the three categories of Class VI systems, the program cost for each Class, and the financial analysis required to support the system.

Financial analyses support the evaluation of alternative investment decisions based on cost considerations. The financial justification for a project becomes more complex as the expected program cost increases. Systems with program costs less than 250 thousand dollars must prepare a budget analysis to ensure the chosen alternative can be funded. Systems with program costs greater than 250 thousand dollars require the preparation of an economic analy

Table 1-1

System Class	Program Cost	Financial Analysis
VI(a)	$1M to $2.5M	Economic Analysis
VI(b)	$250K to $1M	Economic Analysis
VI(c)	$50K to $250K	Budget Analysis
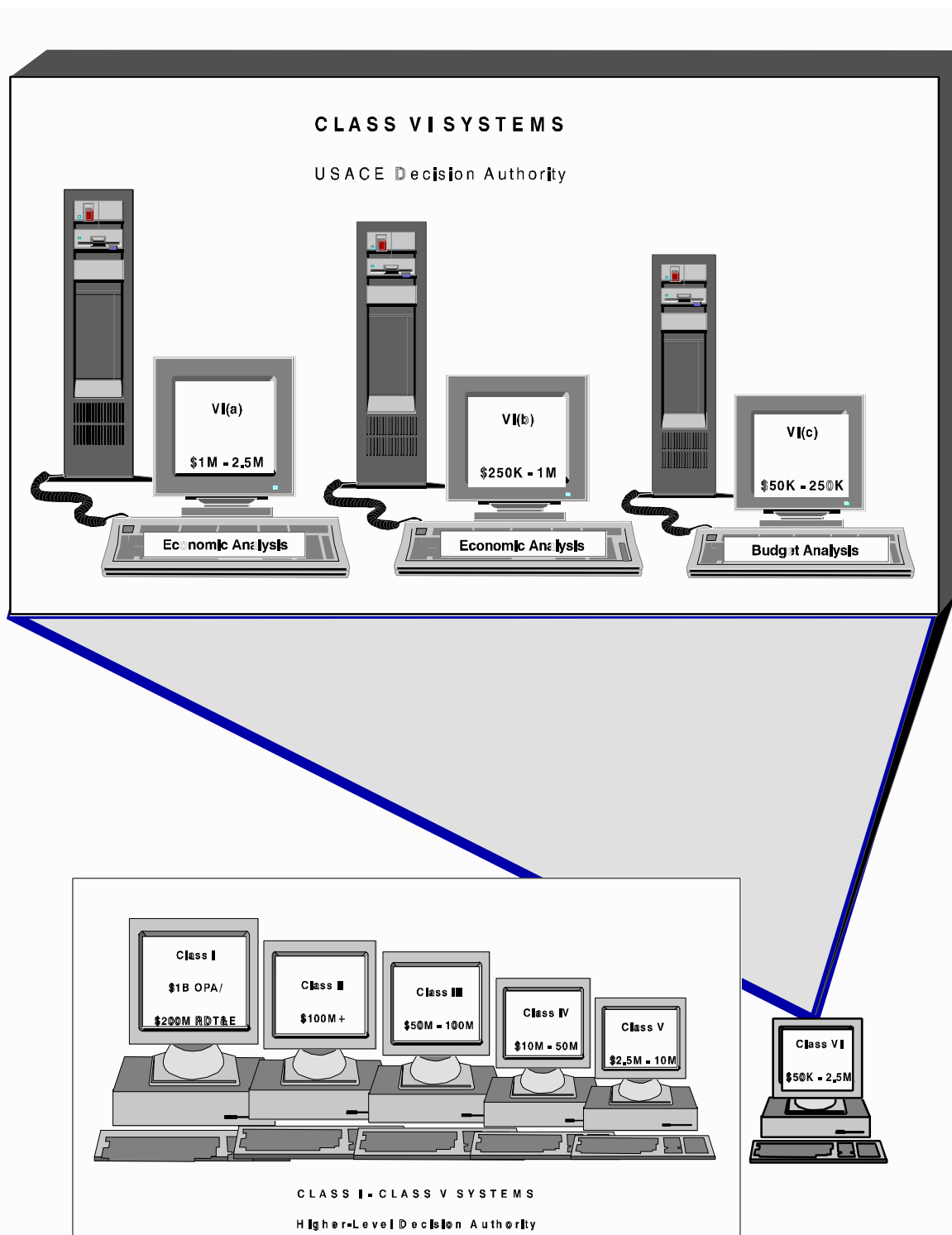
Figure 1-1

sis to ensure cost effective alternatives are being pursued. For systems with program costs below 50 thousand dollars, an analysis is not required and system selection remains at the discretion of management. The different subclasses and guidelines are illustrated in Figure 1-2.

Format of the Handbook

This handbook incorporates guidelines covering each level of financial analysis. *Section 2* provides guidance on how to prepare a budget analysis for Class VI(c) systems with program costs between $50K to $250K. *Section 3* provides guidance on how to

prepare an economic analysis for a Class VI(b) system (program costs between $250K and $1M) and a class VI(a) system (program costs between $1M and $2.5M). Depending upon the likely range of program cost, an analyst can select the appropriate guidelines for the level of analysis required, and use them to structure and present the analysis. *Section 4* of the handbook provides references for further reading, a summary of the Department of Defense's concept of functional economic analysis (FEA; currently undergoing internal review), and additional information for performing financial analyses.
Section 5 of the handbook provides a glossary and index.

LEVELOFANALYSIS

BUDGETANALYSIS   ECONOMICANALYSIS   ECONOMICANALYSIS

COMPONENTSOFANALYSIS

Discuss reasonable alternatives toinclude the current method	Discuss reasonable alternatives to include the current method	Discuss reasonable alternatives toinclude the current method
Determine all costs ofselected alternative	Determine &evaluate allcosts &benefits	Determine &evaluate allcosts &benefits
		Perform sensitivity analysis

$250K $1M $2.5M

RECOMMENDATIONS

ESTIMATEDPROGRAMCOST

Figure 1-2

Budget Analysis

Introduction

Functional proponents, in partnership with the Information Management community, are responsible for handling acquisition, overseeing the installation of hardware and software, and ensuring effective system operation and maintenance. Frequently, the project manager must also function as a cost analyst to select an appropriate solution that satisfies both the functional and budgetary requirements. This section illustrates how to complete a Budget Analysis. In this process, the analyst must consider reasonable solutions to satisfy a problem, then select one for life-cycle costing. A Budget Analysis documents the costs of a relatively modest systems resource acquisition, and is performed when the range of the anticipated program cost is $50,000 to $250,000. Any cost analysis for items below $50,000 is at the discretion of management. The purpose of conducting a Budget Analysis is to ensure the preferred alternative falls within the range prescribed above. Although various approaches are certainly considered as possible solutions, the analysis only includes the preferred investment alternative. This simpler form of analysis is considered appropriate for the modest level of resource acquisition.

General Guidelines for Performing Budget Analysis

1. **Parameters.** The Budget Analysis consists of basic parameters necessary to gather all costs for the selected alternative. An explanation of each parameter is given below:

a. *Start Year.* The first year in which costs occur for the selected alternative. All costs in the Budget Analysis are estimated to reflect the price level of the start year.

b. *Lead Time.* The period of time between initial funding or decision and commencement of the economic life.

c. *Economic Life.* The period of time over which the benefits of the selected alternative are expected to accrue. The economic life of an alternative is often limited by the alternative's physical life (the period of time over which the asset can operationally perform) or technological life (the period before the asset becomes technologically obsolete).

1) In a Budget Analysis, the economic life of an AIS or program for Subclass VI(c) projects ($50 K - $250 K) is generally assumed to be five to seven years.

2) The analyst should note that an AIS comprises various types of equipment, each with its own period of utility, or equipment life. Equipment life is the time during which the equipment of the system is operational without an undue number of repairs and while the vendor continues to provide support. Thus, "equipment life" does not always coincide with "system or economic life." If the life of a certain piece of equipment in an AIS is shorter than the system life itself, the analyst must include equipment replacement or upgrades to enable the system to function over its entire life. Guidance regarding the lives of various resources can be found in DA PAM 25-2 and DA PAM 11-2 [Para. 3-2j(3)].

d. *Period of Analysis.* The economic life of the selected system alternative plus the lead time, or the period of time from the start year to the end of the economic life. Figure 2-1 provide a typical example of the relationships among the parameters in a Budget Analysis (**note:** a 5-year economic life and 1-year lead time were used for this example).

2. **Constant Dollars and Inflation.** Inflation is the rise in costs (or prices) of goods and services over time. In a Budget Analysis, inflation is generally not applied to the costs of the selected alternative.

```
      |◄──────── Analysis Period ────────►|

      |◄──►|◄───────────────────────►|
       Lead          Economic Life
       Time


      Start Year

          1     2     3     4     5     6
          |     |     |     |     |     |
          Year   Econ.                   End
          Funds  Life                    of
          Spent  Begins                  Proj.


          |                              |
          |                              |
               Period of Analysis = 6 years
```
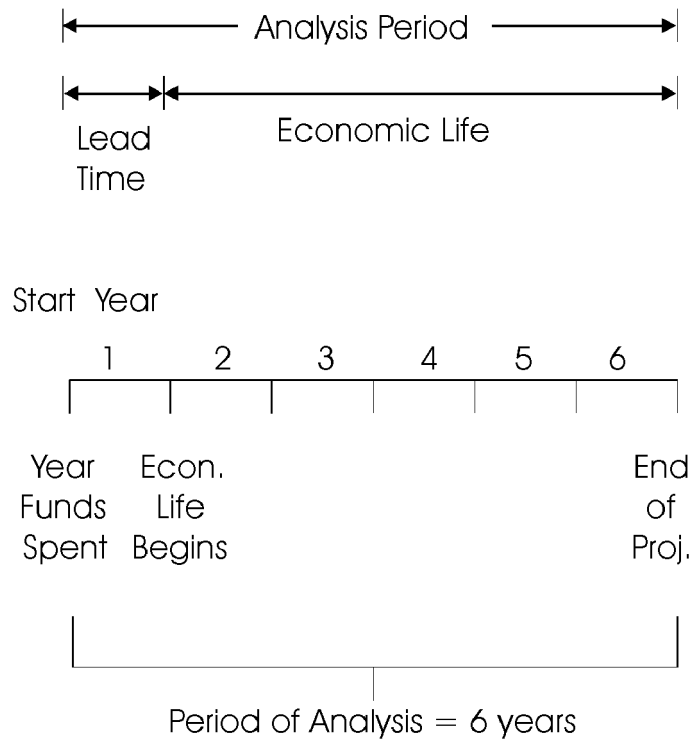
Relationships among key dates
in an Budget Analysis.

Figure 2-1

a. *Constant Dollars.* The Budget Analysis should be done using constant dollars, where costs do not include inflation. The use of constant dollars indicates constant purchasing power in terms of the dollar value of the start year. Thus, all costs of the selected alternative in a Budget Analysis reflect the level of prices for the start year.

b. *Use of Inflation.* In most Budget Analyses, inflation will not be a problem. There may be times, though, when the analyst will have to inflate or deflate certain costs. For example, if cost estimates are obtained in 1997 prices, but the start year of the analysis is not until 1999, these costs must be inflated from 1997 to 1999. A detailed explanation for handling this problem is given in "Step 4: Determine Costs."

Steps to Performing a Budget Analysis

Budget Analysis consists of five basic elements. This section contains a detailed discussion of each step.

1. ***Define the Objective.*** The statement of the mission objective should clearly define the function to be accomplished or the requirement at hand. The objective should be stated in concise, unbiased and, if possible, quantifiable terms.

Perhaps the single most important step in the Budget Analysis is to define the objective. Defining the objective sets the stage for the entire analysis, including

its objectivity. If this step is completed incorrectly, the remaining analysis may be flawed. To define the objective, the analyst must provide a clear, concise, and unbiased statement of the requirement. The objective should also be realistic, and should be expressed in quantifiable or measurable terms.

The following example illustrates how an objective can be correctly and incorrectly defined.

> **PROBLEM:** Managers of the personnel office notice that the employees are always lining up at the three laser printers in the department, wasting valuable productivity time. They recognize that reasonable access to laser printing is a problem that must be solved.
> **CORRECTLY STATED OBJECTIVE:** To provide laser printing capabilities to 72 employees. Capabilities should provide a wait time of no more than three minutes and allow users to continue working while waiting for documents to print.
> **INCORRECTLY STATED OBJECTIVE:** The personnel office needs to provide each employee with a laser printer.

In the example above, the correctly stated objective is in unbiased terms, while the incorrect one is biased

towards purchasing a laser printer for each employee. Thus, the wording is critical in stating the objective. Not only should the objective be unbiased, it should also identify explicit criteria for measuring the results which can be applied to any solution. In the example, the standards are: 72 employees must have laser printing capability, the wait time must not be more than 3 minutes, and all employees must be able to continue to work while printing. Any proposed solution must satisfy all the stated criteria.

Table 2-1 provides a checklist to help the analyst define the objective of the program for a Budget Analysis.

2. ***Formulate Assumptions.*** An assumption is a statement describing unknown factors, data and circumstances that may affect the outcome of the analysis. Assumptions are used to describe the future environment when factual data about the environment are unknown. Often, analysts must formulate assumptions before they can choose alternatives wisely. Assumptions must be stated so that reviewers can assess their impact on the Budget Analysis. Assumptions must also be realistic and logically consistent so that reasonable solutions are being considered, which in turn adds credibility to the analysis. Assumptions should never be used if factual data is available or can be obtained, for they can impact the validity of the analysis.

Table 2-1

Objective Checklist	Complete
Does the objective address the actual problem?	
Is the objective concise and understandable?	
Is the objective formulated in unbiased terms, without stating a specific solution?	
Are specific outputs or results of the requirement clearly described?	
Are explicit criteria for measuring the outputs for results clearly identified?	
Are the requirement and criteria realistic and achievable?	

Formulating assumptions is an iterative process. As the analysis develops, information that was previously unknown will become available to the analyst. The assumptions of the analysis will change and, in turn, lead to refinements in the definition of alternatives. By recognizing this process as being evolutionary, the analyst can adapt and make appropriate adjustments. The result is a sounder and better prepared analysis.

Assumptions can be made on general parameters which pertain to the entire analysis, or on specific aspects of the analysis which apply only to certain alternatives. Some common assumptions include, but are not limited to:

€ the start year,
€ the economic life of a system or piece of equipment,
€ estimated future costs,
€ system or program requirements,
€ time and schedule constraints,
€ physical constraints.

The stated assumptions shown are realistic and account for some uncertainty.

Table 2-2 provides a checklist to help the analyst formulate assumptions for a Budget Analysis.

The following example illustrates how assumptions are correctly formulated.

3. **Identification of Alternatives.** The process of identifying alternatives includes listing and describing all reasonable alternatives to accomplish the requirement, as stated in the objective. Following that, the preferred alternative is selected for further analysis. This shows the decision maker that several options were considered by the analyst.

The following guidelines will assist the analyst in choosing appropriate alternatives to document:

a. *Determining Sources.* The first step in identifying alternative solutions is to determine sources for presenting reasonable alternatives. The analyst often relies on personal experience, professional publications, and cognizant personnel as knowledgeable sources.

b. *Documentation of Alternatives.* After the information has been gathered from the selected sources, all reasonable alternatives (including the status quo) must be documented by specifying the technical characteristics of the solution and describing the components and functions of the automated information system.

c. *Determine Feasibility.* State how the outputs/results meet or fail to satisfy the criteria stated in the objective. This documents the feasibility of the alternatives. An alternative that does not meet the requirements of the stated objective is not feasible. Here, the analyst then states that the alternative

---

```
PROBLEM:  Managers of the personnel      ASSUMPTIONS:
office notice that the employees are     1.  The start year is 1999.
always lining up at the three laser      2.  Lead time (period extending from
printers in the department, wasting          the expenditure of funds to the
valuable productivity time.  They            completion of installation) is
recognize that reasonable access to          one year.
laser printing is a problem that must    3.  The economic life of the selected
be solved.                                   alternative is five years.
OBJECTIVE:  To provide laser printing    4.  Printer use is expected to remain
capabilities to 72 employees.                constant over the period of
Capabilities should provide a wait           analysis.
time of no more than three minutes and   5.  Personnel and workload are
allow users to continue working while        expected to remain constant over
waiting for documents to print.              the period of analysis.
```

Table 2-2

Assumptions Checklist	Complete
Has the economic life of the selected alternative been defined?	
Are the assumptions realistic and logically consistent?	
Is there any uncertainty that should be accounted for?	
Have policy and procedure limitations been considered?	
Have physical limitations been considered?	
Have time related considerations been identified?	
Can verifiable facts replace an assumption?	

was considered but determined to be infeasible, thus precluding it from further consideration. Although the analyst may discover that a few alternatives will be infeasible, it is of vital importance that all reasonable solutions be considered and documented for higher levels of review. From the remaining feasible alternatives, the analyst selects one for further analysis. Normally, the alternative that best meets the requirements is chosen.

Table 2-3 provides a checklist to help the analyst define alternatives for the program and select the preferred alternative in a Budget Analysis.

The following example documents several alternatives, including the status quo. This shows the reviewer that different options to satisfy the require

Table 2-3

Assumptions Checklist	Complete
Have appropriate sources of information for identifying reasonable solutions been utilized and documented?	
Have reasonable alternatives satisfying the requirements stated in the objective been identified?	
Have all alternatives been checked against the measures of outputs or results outlined in the objective?	
Do the alternative descriptions show how measures of the outputs or results meet or fail the measures stated in the objective?	
Have the components and functions of the alternatives been clearly described without obscuring the narrative with too much detail?	
Has the alternative that best meets the requirements been selected?	

PROBLEM: Managers of the personnel office notice that the employees are always lining up at the three laser printers in the department, wasting valuable productivity time. They recognize that reasonable access to laser printing is a problem that must be solved.

PROJECT OBJECTIVE: To provide laser printing capabilities to 72 employees. Capabilities should provide a wait time of no more than three minutes and allow users to continue working while waiting for documents to print.

ASSUMPTIONS:
1. The start year is 1999.
2. Lead time (period extending from the expenditure of funds to the completion of installation) is one year.
3. The economic life of the selected alternative is five years.
4. Printer use is expected to remain constant over the period of analysis.
5. Personnel and workload are expected to remain constant over the period of analysis.

ALTERNATIVES CONSIDERED:
1. *STATUS QUO:* Currently, three PCs have laser printers connected to them. All employees must place their files on a diskette. When an employee wants to print a file they must go to a PC with the laser printer connected and print from there. This causes employees to wait in line to print their documents while others print their's. Because this alternative does not satisfy all of the criteria, it is not feasible.

2. *3270 TERMINAL EMULATION:* Provides 3270 terminal emulation for personal computers (PCs). Users would then dial up the organization's mainframe to submit jobs, directing the output to the centrally located laser printer. This alternative was not selected because the mainframe printer is located on the first floor and would cause employees to travel back and forth between the first and sixth floor several times daily to receive their print jobs.

3. *ONE-FOR-ONE CONNECTION:* Provides for a laser printer to be directly attached to every personal computer. This option is not feasible due to lack of space at individual work stations.

4. *LAN CONNECTION:* This alternative provides laser printer services to all of the employees' personal computers by sharing resources over a LAN. This solution allows the employees to continue working while waiting for documents to print. On average, wait time is approximately 2.5 minutes. Printers would be a shared resource, servicing the individual offices and user clusters of up to eight people. One PC in each cluster would act as the printer server. This alternative, however, was not selected due to the high costs of implementation and maintenance. Both of these costs reflect the LAN's many capabilities, all of which are, except for printing capability, unnecessary for the project objective. Therefore, this alternative was not selected.

5. *LASERBOARD INSTALLATION* (selected alternative): This solution provides efficient and dependable laser printer capability to all employees via their personal computers. A laserboard, connecting up to six employees to a

---

ment were considered, not just the chosen solution. Each alternative is described fully without being obscured by technical details and jargon. All the descriptions specify how the alternatives meet or fail the expected output and results. In addition, documentation which states why a feasible alternative was not selected is also provided.

The following example illustrates the process of identifying alternatives for a Budget Analysis:

4. ***Determine Costs.*** All costs associated with the

selected alternative should be included in the analysis. The source and calculation of each cost must be identified in the analysis as well.

a. *Determine Cost Categories.* Various financial analysis guidelines identify major cost categories and their sub-groupings. In addition to the Corps of Engineers, the Department of the Army and the Department of Defense continually review cost category structures to make analysis more meaningful and to reflect current acquisition strategies. There are elements associated with AIS acquisitions that constitute major cost drivers. These cost drivers basically remain the same, regardless of the structure mandated by the current applicable guideline, and can be categorized as nonrecurring and recurring.

    1) *Nonrecurring Costs* are costs that are paid one time. Examples include investment costs for hardware and software, as well as one-time costs associated with investments such as site activation and initial training.

    2) *Recurring Costs* are those paid on a periodic basis. These are costs associated with operations and maintenance, and include such items as computer or other equipment maintenance, leases, and supplies.

Another type of cost that deserves attention but is not included in the Budget Analysis is the "sunk cost". A sunk cost is an unrecoverable past cost incurred before the start year of the analysis. These costs have no effect on the future and are thus disregarded in the Budget Analysis.

Listed below are the major cost elements considered when conducting financial analyses of Subclass VI resource acquisitions. They are categorized as Investment (Nonrecurring) and Operations (Recurring). A complete list of authorized DA cost elements required for MAISRC-level financial analyses are provided in Appendix B.

INVESTMENT (**NONRECURRING**) COSTS
    Project Management

    Hardware
    Software
    Documentation
    Initial Training
    Site Activation
    Test and Evaluation
    Parallel Operations

OPERATIONS (**RECURRING**) COSTS
    Supplies
    Operations
    Maintenance
    Leases

b. *Gather Data.*

    1) The first activity in gathering data is to think of what data is needed for each cost element. Table 2-4 discusses important points to consider when gathering data.

    2) The second activity in gathering data is to identify the sources for each cost element and their component costs. The following examples provide data sources for various types of information. The list of sources is not inclusive.

    Government Publications: General Service Administration (GSA) price lists can be used to determine the costs of commonly requested hardware and software available at government rates. Most vendors have their own GSA price lists. The government pay scale is used to develop labor costs for various system support

Table 2-4

COST ELEMENT	CONSIDERATIONS
Nonrecurring Costs (One Time Costs)	
1. Project Management	€ Is a special project team required? € How is the project management team made up? Grade levels? € Are there contractors supporting the project management office? € What are the expected annual contractor costs? € Will travel be required by the project team?
2. Hardware	€ Will any new hardware be needed, including CPUs, file servers, and peripherals such as printers? € What is the new hardware configuration? € Is there a contract vehicle for purchasing the hardware? € When will the hardware be upgraded? € What communications equipment is needed? € Will existing modems be used?
3. Software	€ Will the hardware require any new operating software? € What new commercial-off-the-shelf (COTS) or proprietary software will be needed? € When will the software be upgraded? € Will any new application software be required? € What is the estimated time to complete the software development? At what level? Contractors? In-house development? € Any data conversion needed (e.g., from manual to automated, or from system to system)? € What communications software is required?
4. Documentation	€ Will hardware or software technical manuals be required? € Will user manuals be required? € Will manuals be off-the-shelf or developed? € How many manuals are required? At what per unit cost?
5. Initial Training	€ Will training be required? If so, how much? € How many people will be trained? € Will people be trained in a classroom setting? With computer-based instruction? € Is travel required for the training? Per diem?

Table 2-4 (continued)

COST ELEMENT	CONSIDERATIONS
6. Site Activation	€ Will a site survey be required? Who will do the survey? At what GS level or contractor rate? € Will facility modifications or upgrades be required before the system can be installed? € Will additional communications capabilities need to be installed for for the system? Dedicated circuits? Dial-up circuits? What line speed?
7. Test and Evaluation	€ Will testing and evaluation be required? € When and where will it occur? € Will it be completed by in-house or contractor personnel? At what GS level or contractor rate?
8. Parallel Operations	€ Will the current system be maintained while the new system is implemented? For how long? € Who will operate the current system while the new one is being implemented? Government or contractor personnel? € At what GS levels or hourly contractor rates?
Recurring Costs	
1. Supplies	€ What paper products are needed? € What hardware and software products will be required? Tapes? Floppy diskettes?
2. Operations	€ How many people will participate in supporting/operating the system? € Will operators be government personnel or contractors? € What are the GS levels or hourly contractor rates? € What will be the costs for utilizing outside service bureaus, if any (especially under "Status Quo")?
3. Maintenance	€ What is the warranty period for hardware? € What is the warranty period for software? € What are the annual hardware maintenance charges? € What are the annual software maintenance charges?
4. Leases	€ Will any of the hardware or software be leased? What are the annual costs? € Will any communications equipment or lines be leased? What are the annual costs?

functions. Pay rates are determined by the civilian employee's Grade and Step (GS) level. When developing cost estimates, a median rate (Step 5) is assumed within each grade.

U.S. Army Information Systems Command Resource Factors Handbook (USAISC Pamphlet No. 11-2) provides details on the costing of elements, including civilian and military pay, hardware and software, telecommunications, and other operating and support costs.

Professional Publications: Publications such as DataPro are recognized authorities on hardware

and software. These publications contain an indus-
try-wide surveys, detailed technical specifications,
and performance comparisons. The publications con-
tain vendor prices and associated equipment costs
such as installation and maintenance fees. This type
of professional publication can be very useful to
determine alternative solutions to improve system
operations (see Step 3: Identify Alternatives).

Other professional publications include industry
magazines such as Info World, PC Week, and
distributor catalogs such as Black Box Catalog.
These publications typically contain less de-
tailed information than DataPro, though they are
useful for determining costs for a variety of
products.

Contracts: Vendor contracts provide pricing on
products and services over the life of the
contract. Current contracts are especially useful
since they contain the precise cost information
used for recently procured hardware, software
and technical services.

Expired contracts are also useful because they
contain historical information that can be ex-
trapolated into the present or future. For
example, historical contract prices can be used
to project, using inflation, the current cost of
products and services. Cost estimates should be
adjusted for product comparability and normal
price increases.

Cost information can be obtained from contracts
held by the Corps of Engineers as well as from
other government agencies.

Budget and Financial Reports: Budget reports
provide information on planned funding limitat-
ions. Financial reports contain data on expendi-
tures and are particularly useful for conducting
trend analysis and extrapolating future costs.

Site Specific Information: Site specific infor-
mation can be obtained through questionnaires
or interviews. This type of data is valuable
because it is obtained "at the source." Freq-

uently, financial reports provide information
that has been summarized, so that individual
line item costs are indeterminate. Site specific
data can be gathered with the appropriate level
of detail required to adequately support the
analysis. This information also provides the
analyst with an excellent view of how opera-
tions are performed in the current environment.

Project Manager's Office: The Project Manag-
er Office (PM) can supply guidance on what
assumptions should be made in the analysis.
For example, the Project Manager makes the
decisions about what training should be con-
ducted, what personnel will be trained, etc.
Whether or not site surveys are required and
how they should be performed; and what con-
figurations of hardware and software will
ultimately be installed.

3) *Units of Measure:* A useful way to accurately
determine the various costs involved is to break
each cost down into units. Most of the time,
each cost element will have a separate and
distinct methodology, but the basic premise is
the same for all cost elements: how many units
are needed, and what is the per unit cost. Table
2-5 lists the typical units of measure for various
cost elements.

c. *Cost Estimate Timeline.* One way to visualize the
timing and magnitude of each cost for the selected

Table 2-5: Units of Measure for Cost Elements

Nonrecurring Costs	Typical Units of Measure
1. Project Management	number of personnel assigned to project management; salary per year; fringe benefits
2. Hardware	number of pieces of hardware; price per piece of hardware
3. Software	number of commercial off-the-shelf packages; price per package; site licenses; number of upgrades required; price per upgrade; number of lines of code or similar measure; number of estimated hours to program; number of programmers; average hourly cost of programmers
4. Documentation	number of manuals required; cost per manual
5. Initial Training	number of personnel to be trained; number of trainers; number of classes and hours; cost per trainer, trainee, or class; number of days per diem per trainee; average transportation cost per trainee
6. Site Activation	number of square feet to be affected; cost per square foot to activate; number of communication lines to be installed; cost per line
7. Test and Evaluation	number of tests; cost per test; number of personnel involved in test; cost per person to test and evaluate; number of days per diem, if applicable; average cost of transportation
8. Parallel Operations	number of hardware/software units to be maintained; number of months for parallel operations; number of personnel involved; average GS level or average contractor cost
Recurring Costs	Typical Units of Measure
1. Supplies	number of tapes, floppy disks, boxes of paper; printer cartridges; per unit cost
2. Operations	number of personnel; average GS level or average contractor cost; number of hours required
3. Maintenance	number of hardware and software units to be maintained; cost per month or year; cost of maintenance contracts
4. Leases	number of communication lines; amount of square footage; average annual cost per unit
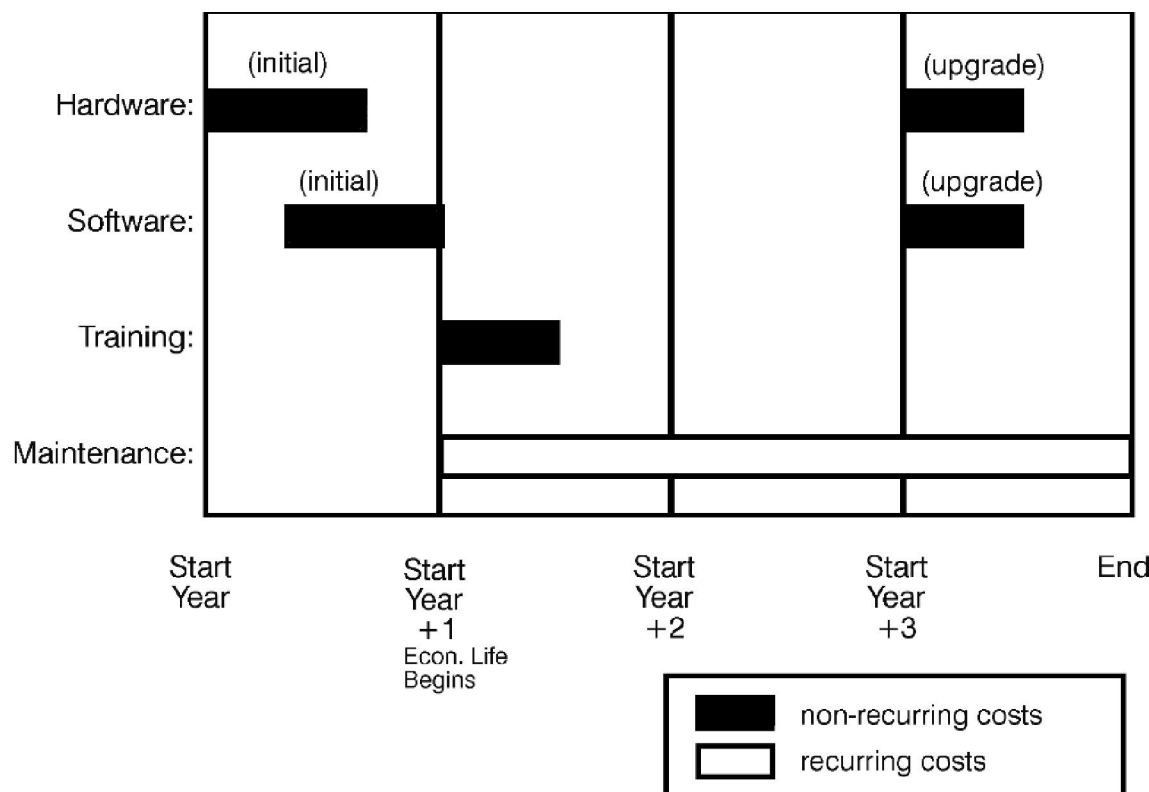
Figure 2-2

alternative is by creating a cost estimate timeline. For illustrative purposes, a four-year period of analysis and a few costs are shown in Figure 2-2. The actual timing, magnitude, and number of costs will vary accordingly.

d. *Cost Documentation.* After the sources have been identified and the costs have been obtained and documented, the analyst must provide a description, calculation and source for each cost. The source and derivation of costs is a very important step in the Budget Analysis. The documentation provides an audit trail and explanation of each

cost. The cost documentation should include the following three elements:

1) *Description of Cost.* A description of all components included in the cost estimate must be provided. The description should include exactly what has been included in the cost calculation.

2) The analyst should include a step-by-step breakdown of the final cost by showing the mathematical calculation. Any inflation that was applied should also be shown in the equation.

3) *Source.* How the cost was estimated is very important. By documenting the source in the analysis, the analyst adds credibility to the analysis.

e. *Handling of Inflation.* Although a Budget Analysis is done in constant dollars (where inflation is not applied to costs), the analyst will sometimes come across inflated or deflated prices when gathering cost estimates. For example, the analyst might only be able to get a cost estimate in 1997 dollars when the start year of the analysis is 1998. Similarly, an analyst might only be provided with 1999 costs when the start year of the analysis is 1998. To address this problem, the analyst must either inflate or deflate the cost estimate(s) to the start year of the analysis.

1) *Inflate cost.* Suppose a cost estimate ($100) is given using 1997 prices, but the start year of the analysis is 1999. Because costs in a Budget Analysis are estimated using start year prices, the analyst must inflate this cost from 1997 prices to 1999 prices. This is done simply by using the 1998 and 1999 inflation rates as shown in the example below. The inflation rates used here are for example purposes only, and the appropriate inflation rates can be found in Appendix D.

```
            1998        1999
 1997  Inflation     Inflation
 1999
 Cost  Rate (5%)     Rate (7%)
 Cost
 $100  x   1.05   x   1.07 = 112.35
```

2) *Deflate Cost.* Similarly, suppose a cost estimate ($100) is given in 1999 prices, but the start year of the analysis is 1997. Because costs in a Budget Analysis are estimated using start year prices, the analyst must deflate this cost from 1999 prices to 1997 prices. This is done simply by using the 1998 and 1997 inflation rates as shown in the example below. The inflation rates used here are for example purposes only, and the appropriate inflation rates can be found in Appendix D.

```
            1998        1999
 1997  Inflation     Inflation
 1999
 Cost  Rate (7%)     Rate (5%)
 Cost
 $100  x   1.07   x   1.05 = 89.01
```

5. ***Report Results and Recommendations.*** The final step in the Budget Analysis is reporting the results and recommendations. The results and recommendations must be clear, concise, and easy to understand. Include a discussion of why the selected alternative was chosen and any important information about the life-cycle costs of the alternatives. It is important to discuss all factors because a decision can be based on qualitative as well as quantitative considerations.

Budget Analysis Report

1. ***Report Format.*** After the Budget Analysis is completed, the results must be communicated in an easily understood format. A complete Budget Analysis report will contain all of the following:

a. *Executive Summary.* The first section of the report should be an executive summary. This section contains the following:

BUDGET ANALYSIS COST DISPLAY					
Year	COST ELEMENTS (actual $s)				Total Annual Outlays
	Hardware	Installation	Maintenance	Supplies	
1999	68,385	3,600			71,985
2000			30,000	23,040	53,040
2001			30,000	23,040	53,040
2002			30,000	23,040	53,040
2003			30,000	23,040	53,040
2004			30,000	23,040	53,040
Total Outlays For Alternative =					337,185

€ the project title,
€ project objective,
€ assumptions,
€ alternatives considered (feasible and infeasible),
€ the selected alternative,
€ results and recommendation.

b. *Life-Cycle Cost Report.* This section contains tables of all of the program costs for the selected alternative. The tables display the occurrences and patterns of costs over the period of analysis. An example cost report is shown on the next page.

c. *Source and Derivation of Costs.* This section documents the sources and derivations for all costs associated with the selected alternative, including all breakdowns and mathematical equations. The following example provides a properly documented cost derivation.

2. **Report Review Guidelines.** The following is a guide for reviewing the Budget Analysis. It can be used as a guideline for both preparers and reviewers of Budget Analyses.

a. *Objective, Assumptions, and Alternatives.*

1) Is the actual problem addressed and stated?
2) Is the objective stated in unbiased terms?
3) Is any assumption too restrictive, broad, or vague?

4) Are uncertainties treated as facts?

5) Are any reasonable alternatives omitted from discussion?

6) Are all alternatives well defined and thoroughly discussed?

```
COST ELEMENT:  Maintenance
1 year contract (includes all
parts and labor;
on call 5 days/week) @
2,500/printer/year
x 4 printers       =  $10,000
Maintenance Total  =  $10,000/yr

Source:  Average of 5 current
vendor maintenance contracts for
laser printers
(ProPrint, Hardware Plus,
CompCity, GraphicsCo, and
Johnny's Laserprinters).
```

b. *Cost Estimates.*

    1) Are all cost-estimating methods used explained and/or appropriate?

    2) Are all relevant costs for the selected alternative included?

    3) Are sunk costs properly excluded?

    4) Are the sources and calculations of the cost data documented? Are they accurate and applicable?

    5) Are all cost estimates in constant dollars? Has inflation been properly excluded?

c. *Parameters.*

    1) Is there any lead time between the investment and the start of the selected alternative's economic life?

    2) Is the economic life of the selected alternative reasonable and its source given?

    3) Is the period of analysis appropriate?

d. *Results and Recommendations.*

    1) Is there adequate justification for the selected alternative?

    2) Does the selection make sense intuitively?

3. ***Example.*** The following is an example of a proper Budget Analysis report. It is important to note that this example is intended only as a guideline for the analyst to follow, for each analysis will be different.

PROJECT EXECUTIVE SUMMARY

Project Title: LASERBOARD INSTALLATION

Period of Analysis: 6 Years

Start Year: 1999

Project Objective: To provide laser printing capabilities to 72 employees. Capabilities should provide a wait time of no more than three minutes and allow users to continue working while waiting for documents to print.

Assumptions:

1. The start year is 1999.

2. Lead time (period extending from the expenditure of funds to the completion of installation) is one year.

3. The economic life of the selected alternative is five years.

4. Printer use is expected to remain constant over the period of analysis.

5. Personnel and workload are expected to remain constant over the period of analysis.

6. All costs were estimated using 1999 prices.

7. No training is required for this alternative.

Alternatives Considered:

1. *STATUS QUO:* Currently, 3 PCs are connected to laser printers. All employees must place their files on a diskette. When an employee wants to print a file they must go to a PC with a laser printer connected and print from there. This causes employees to wait in line to print their documents as others are printing. Since this alternative does not satisfy all of the criteria, it is not feasible.

2. *3270 TERMINAL EMULATION:* Provides 3270 terminal emulation for personal computers (PCs). Users would then dial up the organization's mainframe to submit jobs, directing the output to the centrally located laser printer. This alternative was not selected because the mainframe printer is located on the first floor and would cause employees to travel back and forth between the first and sixth floor several times daily to receive their print jobs.

3. *ONE-FOR-ONE CONNECTION:* Provides for a laser printer to be directly attached to every personal computer. This option is not feasible due to lack of space at individual work stations.

4. *LAN CONNECTION:* This alternative provides laser printer services to all of the employees' personal computers by sharing resources over a LAN. This solution allows the employees to continue working while waiting for documents to print. On average, wait time is approximately 2.5 minutes. Printers would be a shared resource, servicing the individual offices and user clusters of up to eight people. One PC in each cluster

would act as the printer server. This alternative, however, was not selected due to the high costs of implementation and maintenance. Both of these costs reflect the LAN's many capabilities, all of which are, except for printing capability, unnecessary for the project objective. Therefore, this alternative was not selected.

5. *LASERBOARD INSTALLATION* (selected alternative): This solution provides efficient and dependable laser printer capability to all employees via their personal computers. A laserboard, connecting up to six employees to a single printer, would be installed in the existing printers and in nine additional printers that will be purchased. Every personal computer will be connected to a printer with modular cables. The laserboard virtually eliminates printer wait time with its oversized buffer, and every employee will be free to do other tasks on their personal computers while waiting for their print jobs.

Results and Recommendations: The selected alternative is Laserboard Installation. The total life cycle cost of the Laserboard Installation is $337,185 and the program cost falls within the Class VI(C) range of $50K - $250K (note: remember that program costs are costs incurred from project initiation through full deployment). This alternative satisfies all criteria of the project objective in an inexpensive manner, is less costly than a LAN, and does not present the logistical problems associated with the terminal emulation alternative.

LIFE CYCLE COST REPORT

LIFE CYCLE COSTS: LASERBOARD INSTALLATION					
Year	COST ELEMENTS (actual $s)				Total Annual Outlays
	Hardware	Installation	Main-tenance	Supplies	
1999	68,385	3,600			71,985
2000			30,000	23,040	53,040
2001			30,000	23,040	53,040
2002			30,000	23,040	53,040
2003			30,000	23,040	53,040
2004			30,000	23,040	53,040
Total Outlays For Alternative =					337,185

Source and Derivation of Costs

1. Hardware.
   A.   9 laser printers (17 ppm, 600 dpi, dual bins, transparency capability,
        envelope, label, and front/back printing) @ $6,500 per printer = $58,500
   B.   12 Laserboards (6 serial, 1 parallel input) @ $700 per Laserboard = $8,400
   C.   72 modular adapters (1 per each work station) @ $10.20 per adapter = $735
   D.   3,000 feet of modular cabling @ $.25/ft = $750

   Hardware Total = $68,385

   Source: Black Box Catalog, February 1998.

2. Installation.
   240 hours of labor @ 15.00/hour (Washington D.C. area estimate) = $ 3,600

   Installation Total = $ 3,600

   Source: Survey of 5 D.C. area hardware installation firms (Hardware Servicers,
   CompService, ProInstall, TechMasters, and Rp.U.Off and Sons).

3. Maintenance.
   1 year contract (includes all parts and labor; on call 5 days/week) @
   2,500/printer/year x 12 printers = $30,000

   Maintenance Total = $30,000/yr

   Source: Average of 5 current vendor maintenance contracts for laser printers (CompuCity, Graphics Corp., ProPrint, Laser Plus, and JD Inc., Hardware Plus).

4. Supplies.

   A.   2 cases of paper (10 reams per case) per month
        per printer x 12 printers x 12 months@ $30/case = $8,640
   B.   1 toner cartridge per printer per month
        x 12 printers x 12 months @ 100/cartridge = $14,400

   Supplies Total = $23,040/yr

   Source: Prices derived from the previous 12 supply orders for the office.

Economic Analysis

Introduction

The objective of this section is to provide guidance to help functional proponents and project managers understand and develop an economic analysis in support of Class VI(a) and Class VI(b) systems. An economic analysis is performed when the range of the anticipated program cost is in the Class VI(b) range of $250,000 to $1,000,000 or in the Class VI(a) range of $1,000,000 to $2,500,000. An economic analysis supporting a Class VI(a) system requires additional analysis beyond what is required for the Class VI(b) system.

Definition

An economic analysis provides a systematic method for studying problems of choice. Alternative ways to satisfy a requirement are studied by evaluating the quantifiable costs and benefits of each alternative course of action. These costs are assessed objectively using economic techniques so that alternatives can be compared through a numerical ranking.

Purpose

An economic analysis is conducted to ensure the efficient allocation of scarce resources. An organization rarely has adequate funding resources for obtaining all of its needs to meet mission requirements. Thus, decision makers need economic evaluations to help them choose projects. Decision makers must be confident that the most economical and beneficial alternatives to meet a given need are considered in the decision making process. The most cost effective solution among many alternatives is identified and selected by performing an economic analysis.

Economic Analysis Versus Budgeting

Economic analysis and budgeting are completely separate processes. Economic analysis is used to help determine the most cost effective alternative to the government that meets an organization's requirement. Budget analysis provides an organization with the total cost impact of an alternative. Data presented in the economic analysis may or may not be useful in a future budget process. An economic analysis may contain costs over several organizations, making it difficult to use them in the budgeting process for a single organization. Other costs are omitted from the economic analysis because they are wash costs (the same for all alternatives).

Period of Analysis

In order to prepare an economic analysis, it is necessary to determine the number of years over which the alternatives will be compared. This time frame is known at the period of analysis. The period of analysis is the economic life of the selected system alternatives plus their lead time, or the period of time from the start year to the end of the economic life. If the period of analysis differs between the alternatives in the analysis, the alternative with the shortest period of analysis will determine the period of analysis for the economic comparison. The period of analysis begins with the first year in which costs are incurred. The parameters of the analysis period are defined below.

1. *Start Year.* The first year in which costs occur for a selected alternative. All costs in the economic analysis are estimated to reflect the price level of the start year.

2. *Base Year.* The reference year for all present value calculations. Base Year is usually the same as the start year.

3. *Lead Time.* The period of time between initial funding or decision and commencement of the economic life.

4. *Economic Life.* The period of time over which the benefits of the selected alternative are expected to accrue. The economic life of an alternative is often limited by the alternative's physical life (the

period of time over which the asset can operationally perform) or technological life (the period before the asset becomes technologically obsolete). In an economic analysis, the economic life of an AIS or program for Subclasses VI(a) and VI(b) projects is generally assumed to be five to seven years. The analyst should note that an AIS comprises various types of equipment, each with its own period of utility, or equipment life. Equipment life is the time during which the equipment of the system is operational without an undue number of repairs and while the vendor continues to provide support. Thus, equipment life does not always coincide with system's economic life. If the life of a certain piece of equipment in an AIS is shorter than the systems economic life, the analyst must include equipment replacement or upgrades to enable the system to function over its entire life.

Figure 3-1 depicts the relationships among the parameters in an economic analysis.

The Economic Analysis Process

Economic analysis development consists of seven basic steps. By following the seven steps process the analyst will be able to develop a complete and well documented economic analysis. The seven steps in the economic analysis process are shown in Figure 3-2. When preparing an economic analysis in support of a Class VI(b) system ($250,000 to $1,000,000) the comparison of alternatives need only provide a net present value (NPV) ranking of alternatives (Step 5) and Step 6, sensitivity analysis, is not necessary.

Relationships among key dates
in an Budget Analysis.
Figure 3-1

Figure 3-2

These steps have been modified for a Class VI(b) system since the program costs are below $1,000,000. When an economic analysis for a Class VI(a) system is being performed the analyst should perform all seven steps since the program costs are above $1,000,000 and represent major investments.

1. ***Define the Objective.*** The single most important step in an economic analysis is to define the objective. Without a clear, concise statement of what the economic analysis is to evaluate, the economic analysis will not be successful. With this definition, the analyst sets the objectivity of the analysis. An improperly stated objective may indicate that the economic analysis was done to justify a conclusion and not to determine, without bias, the most economical solution for a requirement.

The example at right illustrates how an objective can be correctly and incorrectly defined.

In this example, the correctly stated objective is in unbiased terms, while the incorrect one is biased towards purchasing a laser printer for each employee. Wording is critical in stating the objective. Not only should the objective be unbiased, it should also identify explicit criteria for measuring the results which can be applied to any solution. In the example, the standards are: 50 employees must have laser printing capability, the wait time must not be more

PROBLEM: Managers of the personnel office notice that the employees are always lining up at the three laser printers in the department, wasting valuable productivity time. They recognize that reasonable access to laser printing is a problem that must be solved.

CORRECTLY STATED OBJECTIVE: To provide laser printing capabilities to 24 employees. Capabilities should provide a wait time of no more than three minutes and allow users to continue working while waiting for documents to print.

INCORRECTLY STATED OBJECTIVE: The personnel office needs to provide each employee with a laser printer.

Table 3-1

Objective Checklist	Complete
Does the objective address the actual problem?	
Is the objective concise and understandable?	
Is the objective formulated in unbiased terms, without stating a specific solution?	
Are specific outputs or results of the requirement clearly described?	
Are explicit criteria for measuring the outputs for results clearly identified?	
Are the requirement and criteria realistic and achievable?	

than 3 minutes, and all employees must be able to continue to work while printing. Any proposed solution must satisfy the stated criteria, in order to be considered a viable alternative.

Table 3-1 provides a checklist to help the analyst define the objective of the program for an economic analysis.

2. **Formulate Assumptions.** An assumption is a statement describing unknown factors, data and circumstances that may affect the outcome of the analysis. Assumptions are used to describe the future environment when factual data about the environment are unknown. Often, analysts must formulate assumptions before they can choose alternatives wisely. Assumptions must be stated so that reviewers can assess their impact on the costs and benefits of each alternative. Assumptions must be realistic and logically consistent so that reasonable solutions are being considered, which in turn adds credibility to the analysis. Assumptions should never be used if factual data is available or can be obtained, since they may impact the validity of the analysis.

a. *Formulating Assumptions.* Formulating assumptions is an iterative process. As the analysis develops, information that was previously unknown will become available to the analyst. The assumptions of the analysis will change and, in turn, lead to refinements in the definition of alternatives. By recognizing this process as being evolutionary, the analyst can adapt and make appropriate adjustments. The result is a sounder and better prepared analysis.

b. *Types of Assumptions.* Assumptions can be made on general parameters which pertain to the entire analysis, or specific aspects of the analysis which apply only to certain alternatives. Some common assumptions include, but are not limited to:

€ the start and base years,
€ the economic life of a system or piece of equipment,
€ future costs,
€ system or program requirements,
€ time and schedule constraints,
€ physical constraints.

PROBLEM: Managers of the personnel office notice that the employees are always lining up at the three laser printers in the department, wasting valuable productivity time. They recognize that reasonable access to laser printing is a problem that must be solved.

OBJECTIVE: To provide laser printing capabilities to 24 employees. Capabilities should provide a wait time of no more than three minutes and allow users to continue working while waiting for documents to print.

ASSUMPTIONS:

1. The start year is 1999.
2. Lead time (period extending from the expenditure of funds to the completion of installation) is one year.
3. The economic life of the selected alternative is five years.
4. Printer use is expected to remain constant over the period of analysis.
5. Personnel and workload are expected to remain constant over the period of analysis.

The example above illustrates how assumptions are correctly formulated.

Table 3-2 provides a checklist to help the analyst formulate assumptions for an economic analysis.

3. *Identify Alternatives.* The next step is to list alternatives initially considered to meet the objective. These include all reasonable ways of achieving the objective. While all reasonable solutions to the problem should be identified, it may turn out that some can be rejected initially due to physical, legal, or other implementation constraints that may eliminate the need to incorporate the alternative from further analysis. Alternatives that are not feasible must be discussed in the documentation but need not be included in the cost comparison. An alternative is said to be feasible if it fully meets the stated objective. It is vital that all realistic options be considered and documented.

PROBLEM: Managers of the personnel office notice that the employees are always lining up at the three laser printers in the department, wasting valuable time. Management also recognize that reasonable access to laser printing is a problem that must be solved.

PROJECT OBJECTIVE: Provide printing capabilities to 24 employees. Capabilities should provide a wait time of no more than three minutes and allow users to continue working while ...

ALTERNATIVES CONSIDERED:

1. **STATUS QUO:** Currently, each PC has an employees must place their files on a diskette. When an employee wants to print a file they must go to the PC with the laser printer connected and print from there. This causes employees to wait in line to print their documents while others print theirs. Because this alternative does not satisfy all of the criteria, it is not feasible.

2. *3270 TERMINAL EMULATION:* Provides 3270 terminal emulation for personal computers (PCs). Users would then dial up the organization's mainframe to submit jobs, directing the output to the centrally located laser printer. The mainframe printer is located on the first floor and would cause employees to travel back and forth between the first and sixth floors several times daily to receive their print jobs.

3. *ONE-FOR-ONE CONNECTION:* Provides for a laser printer to be directly attached to every personal computer. This option is not feasible due to lack of space at individual work stations.

4. *LAN CONNECTION:* This alternative provides laser printer services to all of the employees' personal computers by sharing resources over a LAN. This solution allows the employees to continue working while waiting for documents to print. On average, wait time is approximately 2.5 minutes. Printers would be a shared resource, servicing the individual offices and user clusters of up to eight people. One PC in each cluster would act as the printer server.

Table 3-2

Assumptions Checklist	Complete
Has the economic life of the selected alternative been defined?	
Are the assumptions realistic and logically consistent?	
Is there any uncertainty that should be accounted for?	
Have policy and procedure limitations been considered?	
Have physical limitations been considered?	
Have time related considerations been identified?	
Can verifiable facts replace an assumption?	

Table 3-3

Assumptions Checklist	Complete
Have appropriate sources of information for identifying reasonable solutions been utilized and documented?	
Have reasonable alternatives satisfying the requirements stated in the objective been identified?	
Have all alternatives been checked against the measures of outputs or results outlined in the objective?	
Do the alternative descriptions show how measures of the outputs or results meet or fail the measures stated in the objective?	
Have the components and functions of the alternatives been clearly described without obscuring the narrative with too much detail?	
Has the alternative that best meets the requirements been selected?	

The preceding example illustrates the correct process of identifying alternatives for an economic analysis.

The example documents several alternatives, including the status quo. This shows the reviewer that different options to satisfy the requirement were considered, not just the chosen solution. Each alternative is described fully without being obscured by technical details and jargon. All the descriptions specify how the alternatives meet or fail the expected output and results.

Table 3-3 on the following page provides a checklist to help the analyst define and describe alternatives for the economic analysis.

4. **Determine Costs and Benefits.** All differential costs and benefits associated with the feasible alternatives should be included in the analysis. The source and calculation of each cost must be identified in the analysis as well.

a. *Determine Cost Categories.* Various financial analysis guidelines identify major cost categories and their sub-groupings. In addition to the Corps of Engineers, the Department of the Army and the Department of Defense continually review cost category structures to make analysis more meaningful and to reflect current acquisition strategies. There are elements associated with AIS acquisitions that constitute major cost drivers. These cost drivers basically remain the same, regardless of the structure mandated by the current applicable guideline, and can be categorized as nonrecurring and recurring.

Nonrecurring costs are costs that are paid one time. Examples include investment costs for hardware and software, as well as one-time costs associated with investments such as site activation and initial training.

Recurring Costs are those paid on a periodic basis.

These are costs associated with operations and maintenance, and include such items as computer or other equipment maintenance, leases, and supplies.

Two special types of cost must also be discussed, but they are not included in the economic analysis. These special costs are referred to as washed and sunk costs. A wash cost is one that occurs identically for all alternatives. Wash costs can normally be excluded from the economic analysis since they will not affect alternative rankings or the Savings-to-Investment Ration (SIR). However, if the economic analysis results will be used to represent total discounted dollars needed or to be spent, wash costs should be included. A sunk cost is one that will occur before the period of analysis. Sunk costs are past history. They will have no bearing on the future and are therefore disregarded in the economic analysis.

Listed below are the major cost elements considered when conducting financial analyses of Subclass VI resource acquisitions. They are categorized as Investment (Nonrecurring) and Operations (Recurring). A complete list of authorized DA cost elements required for MAISRC-level financial analyses are provided in Appendix B.

INVESTMENT (**NONRECURRING) COSTS**
     Project Management
     Hardware
     Software
     Documentation
     Initial Training
     Site Activation
     Test and Evaluation
     Parallel Operations

OPERATIONS (**RECURRING**) COSTS
     Supplies
     Operations
     Maintenance
     Leases

b. *Gather Cost Data.*

1) The first activity in gathering data is to think of what data is needed for each cost element. Table 3-4 discusses important points to consider when gathering data.

2) The second step in gathering data is to identify sources for each cost element and their component costs. The following examples provide data sources for various types of information.

Government Publications: The General Services Administration (GSA) price lists can be used to determine the costs of commonly requested hardware and software available at government rates. The government pay scale can be used to develop labor costs for various systems support functions. Pay rates are determined by the civilian employee's Grade and Step (GS) level. When developing cost estimates, a median rate (Step 5) is assumed within each grade.

U.S. Army Information Systems Command Resource Factors Handbook (USAISC Pamphlet No. 11-2) provides details on the costing of elements, including civilian and military pay, hardware and software, telecommunications, and other operating and support costs.

Professional Publications: Publications such as DataPro are recognized authorities on hardware and software. These publications contain an industry-wide surveys on computer products, detailed technical specifications, and performance comparisons. The publications contain vendor prices and associated equipment costs such as installation and maintenance fees. This type of professional publication can be very useful to determine alternative solutions to improve system operations (see Step 3: Identify Alternatives).

Other professional publications include industry magazines such as Info World, PC Week, and distributor catalogs such as Black Box Catalog. These publications typically contain less detailed information than DataPro, though they are useful for determining costs for a variety of

computer products.

Contracts: Vendor contracts provide specific information on products and services over the life of the contract. Current contracts are especially useful since they contain the precise cost information used for recently procured hardware, software and technical services.

Expired contracts are also useful because they contain historical data that can be extrapolated into the present or future. For example, historical contract prices can be used to project, using inflation, the current costs of products and services. Cost estimates should be adjusted for product comparability and normal price increases.

Cost information can be obtained from contracts held by the Corps of Engineers as well as from other government agencies.

Budget and Financial Reports: Budget reports provide information on planned funding limitations. Financial reports contain data on expenditures and are particularly useful for trend analysis and extrapolating future costs.

Site-specific Information: Site-specific information can be obtained through questionnaires or interviews. This type of data is valuable because it is obtained at the source. Frequently, financial reports provide information that has been summarized, so that individual line item costs are indeterminate. Site-specific data can be gathered with the appropriate level of detail required to adequately support the analysis. This information also provides the analyst

Table 3-4

COST ELEMENT	CONSIDERATIONS
Nonrecurring Costs (One Time Costs)	
1. Project Management	€ Is a special project team required? € How is the project management team made up? Grade levels? € Are there contractors supporting the project management office? € What are the expected annual contractor costs? € Will travel be required by the project team?
2. Hardware	€ Will any new hardware be needed, including CPUs, file servers, and peripherals such as printers? € What is the new hardware configuration? € Is there a contract vehicle for purchasing the hardware? € When will the hardware be upgraded? € What communications equipment is needed? € Will existing modems be used?
3. Software	€ Will the hardware require any new operating software? € What new commercial-off-the-shelf (COTS) or proprietary software will be needed? € When will the software be upgraded? € Will any new application software be required? € What is the estimated time to complete the software development? At what level? Contractors? In-house development? € Any data conversion needed (e.g., from manual to automated, or from system to system)? € What communications software is required?
4. Documentation	€ Will hardware or software technical manuals be required? € Will user manuals be required? € Will manuals be off-the-shelf or developed? € How many manuals are required? At what per unit cost?
5. Initial Training	€ Will training be required? If so, how much? € How many people will be trained? € Will people be trained in a classroom setting? With computer-based instruction? € Is travel required for the training? Per diem?

Table 3-4 (continued)

COST ELEMENT	CONSIDERATIONS
6. Site Activation	€ Will a site survey be required? Who will do the survey? At what GS level or contractor rate? € Will facility modifications or upgrades be required before the system can be installed? € Will additional communications capabilities need to be installed for for the system? Dedicated circuits? Dial-up circuits? What line speed?
7. Test and Evaluation	€ Will testing and evaluation be required? € When and where will it occur? € Will it be completed by in-house or contractor personnel? At what GS level or contractor rate?
8. Parallel Operations	€ Will the current system be maintained while the new system is implemented? For how long? € Who will operate the current system while the new one is being implemented? Government or contractor personnel? € At what GS levels or hourly contractor rates?
Recurring Costs	
1. Supplies	€ What paper products are needed? € What hardware and software products will be required? Tapes? Floppy diskettes?
2. Operations	€ How many people will participate in supporting/operating the system? € Will operators be government personnel or contractors? € What are the GS levels or hourly contractor rates? € What will be the costs for utilizing outside service bureaus, if any (especially under "Status Quo")?
3. Maintenance	€ What is the warranty period for hardware? € What is the warranty period for software? € What are the annual hardware maintenance charges? € What are the annual software maintenance charges?
4. Leases	€ Will any of the hardware or software be leased? What are the annual costs? € Will any communications equipment or lines be leased? What are the annual costs?

with an excellent view of how operations are performed in the current environment.

Project Manager's Office: The Project Manager's Office (PMO) can supply guidance on what assumptions should be made in the analysis. For example, the Project Manager makes the decisions about what training should be conducted, what personnel will be trained, etc; whether or not site surveys are required and how they should be performed; and what configurations of hardware and software will ultimately be installed.

3) The third activity in gathering data is to collect the information from sources based on the stated objective and assumptions. For example, after the hardware/software configurations for each alternative are determined, the analyst should consult government contracts, conduct telephone surveys, and research DataPro for information on the pricing, installation, and maintenance of the products. It is important to check multiple sources to ensure that both high and low cost estimates are considered. As a general rule, cost estimates should be realistic and conservative.

c. *Gathering Benefits Data.* The main benefit to be derived from an AIS is fulfillment of the stated objective. This is a benefit common to all alternatives in the economic analysis, and its inclusion in the economic analysis calculations would not affect the ranking of the alternatives. So, dollar quantification of the major benefit is unnecessary. Emphasis is therefore placed on the costs of the alternatives. If dollar exist quantifiable benefits (other than meeting the stated objective) for an alternative, they are treated as cost offsets for that alternative.

d. *Cost Estimation Methods.*

1) Perhaps the most difficult phase of an economic analysis is the estimation of costs. However, this part of the economic analysis is crucial because the results will only be defendable to the extent that the cost estimates are reliable. Estimates can never be 100 percent precise as they are made several years before the costs will actually occur. Estimates must be as precise as possible given the constraints on the analyst in performing the economic analysis. Precision is usually obtained by acquiring as much detailed data as possible. Most cost estimates are based on historical data.

2) The analyst chooses the proper level of detail and accuracy in the estimates. These must be weighed with the time allowed to obtain the estimates. Detail and accuracy can be of three levels:

a) *Order of magnitude estimates.* The accuracy of these estimates is very low and can differ from the actual cost by as much as 50 percent. These are used when there is not enough time, funds, or both to do a detailed estimate or when the magnitude of the cost is so small that large inaccuracies will not be a determining factor in the analysis.

b) *Good estimates.* Good estimates are those for which accuracy is within 10 percent of the actual cost.

c) *Detailed estimates.* These estimates will normally be within 5 percent of the actual costs. They are often derived from detailed plans or from accurate historical records. These estimates should be used when possible to ensure the validity of the analysis.

Cost estimates must be made with care and with full knowledge of their limitations. The limitations (assumptions) must be fully documented in the economic analysis re-

port.

e. *Constant Dollars and Inflation.* Inflation is the rise in costs (or prices) of goods and services over time. In an economic analysis, inflation is generally not applied to the costs of the alternatives.

1) *Constant Dollars.* The economic analysis should be done using constant dollars, where costs do not include inflation. The use of constant dollars indicates constant purchasing power in terms of the dollar value of the start year. Thus, all costs for each alternative reflect the level of prices for the start year.

2) *Use of Inflation.* In most economic analyses inflation will not be a problem. There may be times, though, when the analyst will have to inflate or deflate certain costs. For example, if cost estimates are obtained in 1997 prices, but the start year of the analysis is not until 1999 inflation must be applied to change 1997 dollars into 1999 dollars. Current inflation rates can be found in Appendix D.

5. **Compare costs and benefits.** This step is the heart of the analysis. It is also the easiest, because once the first four steps have been completed, the comparisons and ranking can be done using computer programs. Comparisons give managers the information needed to make informed decisions. Once the costs and benefits for all options are found, one option can be compared with another. The general criterion used to compare and rank alternatives is net present value (NPV), which determines the least cost solution for a given level of effectiveness.

Economic analysis alternatives are compared and ranked using present values of costs and benefits. The concept of time value of money is fundamental to economic analysis and must be understood before other aspects of the analysis can be discussed. The value of $1,000 today is not the same as $1,000 five years from now. Money is a productive commodity

and there is a price for its use. This price is called interest. Interest is expressed as a percent or decimal representing the fractional amount of a loan the borrower must pay the lender within a specified interval of time.

a. *Present Value and Discounting*

1) *Compound interest.* Suppose an amount of money, P, is borrowed today at an annual interest rate, i. The amount of money, P, is called the principal. Assume that the money is to be repaid at the end of 1 year. At that time, the borrower will have to pay the lender not only the principal, P, but an additional amount, (P x i). This surcharge, P(i), is the price (interest) the borrower must pay for the use of the money for the year that the loan is outstanding. So, the total future amount, F1, paid to the lender is:

$$F1 = P + Pi = P(1 + i) \quad \text{(Equation 1)}$$

Now suppose the above loan is to be repaid at the end of 2 years instead of 1 year. The amount which would have been repaid at the end of year 1 is $P(1 + i)$, as shown in equation 1. This becomes the principal during the second year; that is, the interest has been compounded at the end of year 1. The amount repaid at the end of year 2 is:

$$F2 = P(1 + i) + [P(1 + i)]^i$$
$$= P(1 + i)(1 + i) = P(1 + i)^2 \quad \text{(Equation 2)}$$

In equation 2, $P(1 + i)$ takes the place of P in equation 1. To compute compound interest for, n, years, the same reasoning is used. The general equation for the total amount to be repaid to a lender at the end of, n, years for an amount, P, loaned today at an annual rate of interest, i, is:

$F_n = p(1 + i)^n$ (Equation 3)

Another way of viewing this loan is that the future value to the lender of, P, dollars today is $P(1 + i)^n$ dollars, n, years from today. The borrower, in order to secure, P, dollars today, is willing to pay $P(1 + i)n$ dollars n years from today. The lender and borrower complement each other as, P, dollars today and $P(1 + i)n$ dollars n years from now are equivalent. Using equation 3, any principal amount can be converted to a future value.

2) *Discounting.* The reverse is also true. Rearranging the equation, any future amount can be converted to its present value. If the principal, P, in equation 3 is viewed as the present value (PV) of the future amount Fn, the relationship can be expressed as:

$$PV = Fn \ \frac{1}{(1 + i)^n} \quad \text{(Equation 4)}$$

In equation 4, Fn represents the dollar amount value, n, years in the future of an investment today at an interest rate, i. The PV represents a cash equivalent in today's dollars (that is, a present value or present worth). The quantity $1/(1 + i)^n$, which is a number less than one, reduces the future cash amount, Fn, to its equivalent PV, and is called a discount factor.

The Army is no different from a private investor that seeks the best return on its investments. In Army economic analyses, future costs and benefits are brought to a common point in time so that valid comparisons can be made.

In equation 4 the value of i is called the discount rate. This rate is established by the Office of Management and Budget (OMB). The method used to determine the discount rate for DOD capital investments is described in OMB Circular A 94, and can be found in Appendix C which is updated annually. It proposes that the discount rate for government investment

analysis be tied to the rate at which the Federal Government is willing to borrow money.

3) *Discounting Factor.* Timing of costs is important in an economic analysis. So, the discount rate is different based on when the costs occur; end of year or mid year. End of year means that the cost or benefit occurs at the end of a year whereas mid year factors are used for costs and benefits occurring in the middle of the year. If they occur evenly during the year, it is customary to use the total for the year and use a mid year factor. Equation 4 is used to calculate both end of year and mid year factors. As an example, to calculate the end of year factor for 10 years, simply use 1 for, Fn, and 10 for the value of n; to calculate the mid year for 10 years, use 9.5 for the value of n.

4) *Summary.* Money is a productive commodity and as such commands a premium, called interest, for its use. Because of this, there is a time value associated with money. A dollar today is worth more than a dollar 5 or 10 years from now. (A dollar today can be invested and earn interest.) Investors take this fact into account when analyzing an investment proposal involving expenditures and receipts at varying points in time. To make meaningful comparisons, costs and benefits must be converted into equivalent costs and benefits occurring at a single point in time. This point is usually the present or the time of analysis. Equation 4 is used to convert future values to that time.

b. *Methods of Economic Analysis*

1) *General.* This chapter describes five economic analysis methods used to compare alternatives. Each method includes examples of how and when to use it. For a Class VI(b) system the only method that should be used to rank alternatives is net present value (NPV). In addition to net present value, other methods can also be calculated to help support economic analyses

performed for Class VI(a) systems. Other available methods are discussed below, **but net present value must always be calculated** for both Class VI(b) and VI(a) systems.

2) *Net present value (NPV).* This method is used when all alternatives meet the mission require-ment over the same period of analysis. This method is the standard way to compare alter-natives in the Army. It is the only method recognized by OMB Circular A 94 for econom-ic analyses. NPV is calculated for each alterna-tive. The alternatives are ranked and the one with the lowest NPV is the preferred option. The NPV is calculated for an alternative by discounting the value of the costs minus the benefits for each year and summing over the years for a total or net value.

3) *Savings/investment ratio (SIR).* Economic anal-ysis finds the most economical way to meet a requirement, given that there is more than one alternative. However, there is the possibility a given requirement may already be met at the present time, but a better solution could be found. In the context of economic analysis, better specifically means that the total NPV cost of an alternative is lower than that of the exist-ing alternative (the status quo) over the same period (economic life). In such a case, the justification for implementing another alter-native is economic; the analysis supporting the proposal is called a primary economic analysis.

In addition to comparing a proposed alternative with the status quo by examining the total NPV costs, another method is used for primary analyses the savings/investment ratio (SIR). SIRs compare the profit potentials of the alter-natives. SIR means exactly what it states the ratio of savings resulting from an alternative (to the present method) to the investment required for implementing the new alternative. An SIR value of 1.0 means that the savings NPV equals the investment cost NPV required to effect

those savings. Thus, for an investment to be economically feasible, the SIR must be greater than one.

If there are several alternative(s), their SIRs can be compared (ranked). However, the analyst must assess other implications of the analysis such as amount of the investment and the sav-ings. For example, one alternative might have an SIR of 5.0 while another has an SIR of only 2.0. Normally, the one with the higher SIR would be preferred. But if the total savings over the analysis period for the option with the higher SIR is very small in total discounted dollars compared with the savings from the other option, the one with the smaller SIR may be preferred.

The SIR is used only to compare investment costs to savings to determine if the investment costs can be recovered through savings.

When computing an SIR, total annual mainte-nance and operations are not discounted, only the difference between annual costs for the two alternatives. The crucial question is: Are the recurring savings of the alternative relative to the status quo enough to justify the investment costs needed to implement the alternative.

For an alternative A to a status quo Q, the total PV savings of A relative to Q can be calculated by equation 5.

$$PV(S) = PV(A1\ Q1) + PV(A2\ Q2) + \ldots + PV(An\ Qn) \qquad \text{(Equation 5)}$$

where S is savings, PV is present value of, I is investment, and Ai and Qi are yearly costs. Thus, the SIR is as shown in equation 6.

$$SIR = \frac{PV(S)}{I} \qquad \text{(Equation 6)}$$

If the investment extends over more than 1 year, it should also be discounted as in equation 7.

$$SIR = \frac{PV(S)}{PV(I)} \qquad \text{(Equation 7)}$$

4) *Discounted payback period (DPP).* An easily understood method of comparing alternative investments or for evaluating a single investment is "payback analysis." Payback period is the time required for the total accumulated savings or benefits of a project to offset investment costs. So, if a project cost $100 and yielded annual savings of $25, its undiscounted payback period would be 4 years. DPP is often used in conjunction with the SIR. If the SIR is greater than 1.0, indicating the project pays for itself, the question then becomes "How long does it take to recoup the investment costs." DPP, like SIR, is used with the NPV as an aid in selecting the best alternative.

   a) Duration of project life has no effect on the payback period. For example, a payback period of 10 years has the same meaning whether the economic life is 15 or 25 years. Thus, the payback period can be used to help rank alternatives. Options with quick payback are generally preferred.

   b) The time value of money must be considered in payback computations. So, all costs must be discounted to compute a DPP. Payback is achieved when total accumulated PV savings are enough to offset the total PV costs of an alternative. The payback period is simply the total time between the point when savings begin to accrue and the point at which payback occurs.

5) *Benefit/Cost Ratio (BCR).* A complete economic analysis will identify and quantify all relevant costs and benefits of each alternative. Both costs and benefits expected for each alternative

will be considered.

"Benefits" is an overall term for returns (savings, outputs, products, or yields). The benefits of each alternative must be expressed so that the decision-maker can make valid comparisons. This step is done using the benefit/cost ratio (BCR) method. In general the BCR is expressed as shown in equation 8.

$$BCR = \frac{NPV \text{ of Benefits}}{NPV \text{ of Costs}} \qquad \text{(Equation 8)}$$

Benefits are measured in dollars. Total benefits relative to total costs are measured. The larger the BCR, the more cost effective the alternative.

   a) *Benefit types.* In general, four types of benefits are potentially associated with AIS projects. These benefits are not mutually exclusive. They include:

      (1) Direct cost savings.
      (2) Efficiency/productivity increases.
      (3) Nonquantifiable output measures.

   b) *Direct cost savings.* When direct cost savings are the main reason for performing an economic analysis, a primary economic analysis is usually done. The key aspect is that savings accrue, usually in the form of a reduction in recurring O&M costs. That is, after an initial investment, the funding level needed for the facility and its function will be reduced in future years. When the NPV of these savings exceeds the investment, the project pays for itself over its economic life and is self amortizing. A primary economic analysis is performed for such projects. The self amortizing is demonstrated by an SIR greater than one.

   c) *Efficiency/productivity increase ratio*

(EPIR). Often automation projects increase an operation's efficiency or productivity. These increases are very beneficial and should be included in the BCR analysis when they exist. Benefits of this type are often confused with direct cost savings because they are easy to quantify in dollar terms. However, they are not equal, and the analyst should understand the basic difference.

An increase in efficiency or productivity implies only one result: the ability to do more work within the existing manpower and funding levels. One way to translate an efficiency/productivity increase into direct cost savings is to effect a reduction in force (RIF) which lowers the required personnel funding level. The other way is to use the same manpower level to meet an increased workload requirement. A RIF is not usually intended as one of the required results and thus some other means of quantifying efficiency/productivity benefits must be used.

An efficiency/productivity increase that translates into a labor/time savings of 2 man years is a benefit whose value can be defined as what it would cost the Army to pay for an additional 2 man years of labor. This cost should be accelerated by the appropriate rates for leave and fringe benefits because the value of the benefit should reflect the actual total cost to the Army of providing 2 man years of work.

One very important policy must be mentioned at this point. To claim an efficiency/productivity increase as a valid benefit, there must be a documented need for the increased work load capacity. In other words, there must be an alternative use to which the manpower resources now available can be applied, such as reducing a

backlog of maintenance. Without this justification, there is no quantifiable benefit derived from the project.

d) *Nonquantifiable output measures.* It is not always possible to quantify some benefits such as improved morale, and other qualitative benefits. However, they should be documented in the economic analysis report for consideration by the decision-makers. These written qualitative benefit descriptions can make a positive contribution to the economic analysis. Statements on qualitative benefits should follow these guidelines.

1) Identify all benefits associated with each alternative and give complete details.

2) Identify benefits common in kind but not in extent or degree among alternatives, and explain the differences.

3) Avoid platitudes. For example, all prospective projects are worthwhile because they support national defense, and statements to this effect are not needed.

4) Display the benefits in tabular form as shown in Table 3-5.

Table 3-5

Matrix of Benefits

	Increased Morale	Safety	Work Quality
Alt A	Yes	Same	Better
Alt B	No	Same	Same

6) *Summary.* This paragraph has outlined methods that can be used to evaluate and portray benefits in a benefit/cost analysis framework. These methods are not exhaustive, but illustrate approaches the analyst can take to evaluate the benefits of different options. Analysts should use these methods in addition to any others they find appropriate. If a unique method is used, the analyst should clearly and completely explain, justify, and document it for the economic analysis report. Negative aspects of an alternative should also be reported and quantified when possible. This information is important to the decision maker and may be a determining factor in selecting an alternative.

7) *Methods.* The methods described can be used to perform economic analyses for all automated information systems. Some methods work better for certain combinations of costs and alternatives than others. Once an analyst has done several economic analyses, selection of the method(s) will become second nature.

6. ***Perform Sensitivity Analysis.*** A sensitivity analysis is a "what" if exercise. It tests whether the conclusion of an economic analysis will change if some variable such as a cost, benefit, or discount rate changes. This step should only be performed when you are comparing alternatives in a Class VI(a) system (program cost of $1,000,000 to $2,500,000).

a. Sensitivity analyses should always be performed for a Class VI(a) system when:

1) The results of the economic analysis do not clearly favor any one alternative.

2) There is a great deal of uncertainty about a cost, benefit, or assumption in the economic analysis.

3) If a change in a variable or assumption causes a change in the ranking of alternatives, the economic analysis is said to be "sensitive" to that

variable or assumption. By performing a sensitivity analysis and including its results in the report, the analyst ensures the decision maker that uncertainties in the economic analysis have been tested and the results documented.

b. Once all costs and benefits have been estimated, the analysis can be performed and the alternatives ranked to show which is economically best. However, the analysis is not complete until it has been examined for areas of uncertainty. Sensitivity analyses are used to evaluate the effect of these uncertainties on the ranking of the alternatives.

1) Some uncertainty is always present in economic decision making and, thus, some type of sensitivity analysis must normally be done in an economic analysis. In an economic analysis, future costs are predicted and there is an element of uncertainty about these data. Even if actual cost data from past projects are used, it is assumed that these data are an accurate estimate of future costs. Thus, all data used in calculating life cycle costs are actually based on assumptions. The sensitivity of an analysis is tested by evaluating a range of estimates for critical cost elements. The sensitivity analysis measures the percent change in one or more elements of an economic comparison that will reorder the ranking of alternatives.

2) No single criterion can be used to select the most important parameter or factor to be considered in sensitivity analysis. Each analysis has its own set of costs and assumptions.

3) A general rule when considering cost data is to examine the input variables. Variables that significantly impact the total NPV or the benefits of an alternative are good candidates for sensitivity analysis. An easy way to find these variables is to examine the percentage values of the present value of each cost against the net present value of the alternative. A rule of thumb is to examine all costs which are 20

percent or more of the total NPV for an alternative.

4) A sensitivity analysis is developed by asking the question: which input variables should be tested? That is, are there dominant costs with uncertainties concerning their magnitudes or their times of occurrence? Assumptions and constraints must be examined to determine if their variation affects the input variables.

5) As in the entire economic analysis process, the analyst should use common sense in deciding which sensitivity analyses to perform. If the ranking of alternatives shows that one is much less costly than the others, it is probably not necessary to evaluate small changes in costs that have no chance of reversing the ranking. It is when the magnitude or timing of a cost may affect the ranking or when the economic choice is not clear cut that further investigation is needed. There is no formal theory for performing sensitivity analyses.

6) The analyst should not make the sensitivity analysis too complex, as interpretation can be very difficult. A good guide is to study only two alternatives at a time and vary the uncertain costs within each alternative in the same way (an increase or decrease).

7) The analyst should have a range of values of the uncertainty in mind before doing the sensitivity analysis. For example, the uncertainty should be envisioned as ranging from 50 to 150 percent of the estimate or, say, from 70 to 100 percent of the estimate.

7. **Report Results and Recommendations.** Upon completion of the economic analysis, the results must be communicated to the decision makers in an easily understood format. The report should contain summary data for the life cycle cost analysis of each alternative, appropriate graphs, and summaries of any sensitivity analyses. In addition, it should present conclusions and recommendations. A complete report will contain all of these elements.

a. *Executive summary.* The first section of the report should be an executive summary. This section gives the objective, alternatives considered (feasible and nonfeasible), ranking of alternatives, conclusions, and recommendations. It also lists any assumptions made for the analysis. It gives some details such as the discount rate, period of analysis, and start and base years.

b. *Detailed life cycle cost analysis.* This section presents tables of detailed costs for each alternative in each year of the analysis. These tables show the occurrences and patterns of costs over time for each alternative. The sources and derivations for costs are also given in this section.

c. *Graph of NPVs.* A graph showing cumulative NPV for each alternative over time should be included.

d. *Sensitivity analysis.* This section should begin with a paragraph discussing which costs need to be examined in sensitivity analyses. Then results of varying these costs effects on the alternatives' rankings are given.

e. *Source Derivation.* This section should provide a description, calculation, and source for all costs included in the economic analysis. This is very important as an audit trail to the analysis.

ECONPACK Computer Program For Economic Analysis

1. Proper preparation of an economic analysis re-quires a major effort to gather data, do mathematical calculations, and summarize results into required report formats. Use of currently available computer programs can reduce the time required, ensure correct calculations, and produce results that comply with DOD guidance. A word of caution: results from computer runs are only as good as the data input -- valid data must be used.

a. PC ECONPACK software is an economic analysis computer package available throughout USACE. PC ECONPACK incorporates economic analysis calculations, documentation, and reporting capa-bilities to allow the non-economist to prepare complete and properly documented economic analyses. These programs can be obtained from HQUSACE (CEMP MC). Appendix E provides a sample computer output.

b. Examples of economic analysis reports generated by ECONPACK Appendix E shows examples of typical economic analysis reports as generated by ECONPACK. If an economic analysis is not generated on ECONPACK, results should be reported as described above. Formats for present-ing results should be as shown in the reports for the examples of appendix E.

EXAMPLES

1. *Example One.* The following is an example of a Class VI(b) system Economic Analysis. Please note that the Class VI(b) system Economic Analy-sis requires only net present value calculations. Thus, there are no cost sensitivity tests, SIR, DPP, etc.

PROJECT EXECUTIVE SUMMARY

Project Title: WORKGROUP INSTALLATION

Period of Analysis: 6 Years

Start Year: 1999 Project

Project Objective: To provide electronic file processing and sharing capabilities, as well as laser printing capabilities to 50 employees. Every employee should have the ability to exchange and process electronic data at any time, including software applications. Employees should be able to continue working while waiting for documents to print, and the wait time for a job should be no more than 3 minutes.

Assumptions:

1.   The start year is 1999.
2.   The real discount rate used in this analysis is 2.4%.
3.   Lead time (period extending from the expenditure of funds to the completion of installation) is one year.
4.   The economic life of the alternatives is five years; thus, there are no residual values associated with the alternatives.
5.   Printer use is expected to remain constant over the period of analysis.
6.   Personnel and workload are expected to remain constant over the period of analysis.
7.   Software application upgrades are required every two years.
8.   All costs were derived and estimated in 1999 dollars.
9.   All costs were included in the analysis to represent the total outlays and total net present values of each alternative.
10.   PCs and Printers will have a 1-year maintenance-free guarantee.
11.   Due to the minimum hardware specifications of the required software, the existing PCs cannot be used or upgraded and will be excessed.

Alternatives Considered:

1.   *Status Quo:* Currently, all 50 employees must share 10 stand-alone PCs (8086, 64K, CGA monitor) and 7 high quality dot-matrix printers (4ppm) between themselves. The printers are connected to 7 other PCs which are used as print servers. After the employees perform their tasks using paper and pencil, they must then transfer the data into electronic format via a PC. After saving their files on floppy disk, the employees walk over to a printer, insert the disks into a PC connected to a printer, and print out their files. Employees frequently wait to use these limited resources for extended periods of time, and this alternative does not satisfy any of the stated criteria. The Status Quo is not feasible.

2. *SNEAKER-NET SOLUTION:* Under this alternative, every employee in the division would be equipped with a stand-alone PC. Each PC would have Windows and DOS pre-installed, and the software applications would include a word processor, spreadsheet, and graphics package. There would also be 10 laser printers for the entire division, where each group of employees would be connected to a laser printer via laserboard installation. Although the file exchange would occur via manual transport of floppy disks (i.e., walking over to another PC with the disk -- hence the name "sneaker-net", all 50 employees would have electronic data processing and exchange capability, as well as unlimited laser printing access.

3. *WORKGROUP SOLUTION:* This alternative provides 5 unmanaged hubs for small workgroups of 10 employees each. Under this option, the division would be equipped with 50 stand-alone PCs, and every workgroup would be connected through a 12-port hub, twisted-pair Ethernet system. Every PC would come with Windows and DOS, and the software applications would include a word processor, spreadsheet, and graphics package. In addition, 2 laser printers would be connected to each hub (10 total printers), and each workgroup would have access to either printer. This system would enable file sharing and updating to occur electronically for each workgroup, where every employee would have unlimited laser printing access.

Results and Recommendations:

€   *Net Present Value Results*

Alternative Name:	NPV
1. €Sneaker-Net" Solution	$1,205,715
2. Workgroup Solution	$1,253,560

€   *Non-Monetary Benefits*

Alternative 2, the Workgroup Solution, would provide instantaneous data and file exchange for each division workgroup. There would be virtually no wait time involved, and the amount of floppy disks floating around among the work stations would be reduced as well. This equates to a reduction in processing time, enabling the employee to complete tasks in an efficient and effective manner.

The Workgoup Solution also provides for easy upgradeability. The division is exploring the idea of managing its files in a database due to ever-decreasing file cabinet space, and the Workgroup Solution alternative makes this possible simply by loading software on to the system. Similarly, scheduling and communication for the employees can be made available with minimal effort involved. The Workgroup Solution has the potential to provide the division with full automated capabilities.

€   *Recommendation*

Costs and benefits were analyzed over a 6-year period. Annual costs were discounted at a 2.4 percent rate, and then totalled to arrive at a net present value (NPV). The least-cost alternative is the "Sneaker-Net Solution" (Alternative 1), with a NPV of $1.205M, while the Workgroup Solution

(Alternative 2) has a NPV of $1.253M.

Based on the results of the analysis, the Workgroup Solution (Alternative 2) is recommended for funding to meet the requirements. Although it is not the least-cost option, the Workgroup Solution is only $48K more in NPV terms. Additionally, the Workgroup Solution alternative would enable employees to update and transfer files in a more efficient and effective manner. This ultimately results in increased productivity and a higher quality product. The Workgroup Solution would also provide upgradeability to full automation with very little effort.

Action Officer: Mal E. Bu, Project Manager, (123) 456-7890

Organization: Los Angeles District

* Note: Normally, the alternative with the lowest NPV would be the alternative that is recommended for funding. However, there may be other considerations (as demonstrated in this example) that weigh into the decision.

LIFE CYCLE COST REPORT

Calculation of Discount Factors:

CALCULATION OF DISCOUNT FACTORS WHEN i = 2.4%, USING MIDDLE-OF-YEAR DISCOUNTING CONVENTION		
Year n	$1/(1+i)^{n-.5} =$	Discount Factor
1	$1/(1.024)^{1-.5}$	.988
2	$1/(1.024)^{2-.5}$	.965
3	$1/(1.024)^{3-.5}$	.942
4	$1/(1.024)^{4-.5}$	.920
5	$1/(1.024)^{5-.5}$	.899
6	$1/(1.024)^{6-.5}$	.878

* Note: i = the 6-year, real discount rate (remember to use the real discount rate when using constant dollars), and a middle-of-year discounting convention is used because all costs are spread evenly over the year; however, if you are particularly averse to performing mathematical calculations, you can simply turn to Appendix C and use the discount factors listed in the "Middle Of Year Discount Factors" table.

`Life Cycle Cost Reports:`

	ALTERNATIVE 1: SNEAKER-NET SOLUTION							
Year	Cost Elements (actual $s)					Total Annual Outlays	Disc. Factor	Net Present Value of Annual Outlays
	Hard-ware	Soft-ware	Install-ation	Maint. Support	Supplies			
1999	167,450	37,500	30,000			234,950	.988	232,130
2000				150,000	26,850	176,850	.965	170,660
2001		7,500		190,000	26,850	224,350	.942	211,340
2002				190,000	26,850	216,850	.920	199,500
2003		7,500		190,000	26,850	224,350	.899	201,690
2004				190,000	26,850	216,850	.878	190,395

	ALTERNATIVE 2: WORKGROUP SOLUTION							
Year	Cost Elements (actual $s)					Total Annual Outlays	Disc. Factor	Net Present Value of Annual Outlays
	Hard-ware	Soft-ware	Install-ation	Maint. Support	Supplies			
1999	186,600	45,500	35,000			267,100	.988	263,895
2000				152,500	26,850	179,350	.965	173,075
2001		7,500		193,750	26,850	228,100	.942	214,895
2002				193,750	26,850	220,600	.920	202,950
2003		7,500		193,750	26,850	228,100	.899	205,060
2004				193,750	26,850	220,600	.878	193,685
				Total Outlays =		1,343,850	**Total NPV =**	**1,253,560**

Source and Derivation of Costs:

ALTERNATIVE 1: SNEAKER-NET SOLUTION

1. Hardware.
    A. 50 personal computer work stations (486DX2/50MHz CPU, 8 MB RAM,
        340 HD, SVGA Color Monitor, extended keyboard, mouse, pre-loaded
        Windows and DOS) @ $1,750 per work station = $ 87,500
        Source: Based on the average of 5 GSA vendor price lists.

    B. 10 laser printers (17ppm, 600 dpi, dual bins, transparency capability,
        envelope, label, and front/back printing) @ $6,500 per printer = $65,000
        Source: Black Box Catalog, Feb 1998.

    C. 10 printer sharing cards (6 serial, 1 parallel input, oversized buffer)
        @ $700 per card = $7,000
        Source: Black Box Catalog, Feb 1998.

    D. 50 Modular adapters (1 per each workstation) @ $10.20 per adapter $510
        Source: Black Box Catalog, Feb 1998.

    E. 3,750 feet of modular cabling @ $.25/ft = $940
        Source: Black Box Catalog, Feb 1998.

    F. 50 Back-up Systems (250 MB, 1 per workstation) @ $130 per system = $6,500
        Source: DataPro Catalog, Jan 1998.
        Hardware Total =   **$167,450**

2. Software.
    A. 50 Windows software applications packages, which includes word processor,
        spreadsheet, and graphics capabilities @ $750 per work station = $37,500
        Source: Based on the average of 5 software vendor GSA price lists.

    B. 100 software upgrades (2 upgrades per work station) @ $150 per upgrade = $15,000
        Source: Based on the average of 5 software vendor GSA price lists.
        Software Total =   **$52,500**

3. Installation.
    1,500 hours of labor @ $20.00/hour (Washington D.C. area estimate) = $ 30,000
    Source: Survey of 5 D.C. area hardware installation firms.
        Installation Total =   **$ 30,000**

4. Maintenance/Support.

    A. PC Maintenance Contract: 1 year contract @ $300 per work station x 50
       work stations (includes all parts and labor, on call 5 days a week) = $ 15,000/yr
       Source: Historical vendor contracts for maintenance.

    B. Printer Maintenance Contract: 1 year contract (includes all parts and
       labor, on call 5 days a week) @ $2,500/printer/year x 10 printers = $ 25,000/yr
       Source: Average of 5 current vendor maintenance contracts for
       laser printers.

    C. Support: 1 year contract (includes PC and printer trouble-shooting,
       hardware and software support, 40 hours a week) = $150,000/yr
       Source: Survey of 5 vendor support contracts for the Washington, D.C. area.

                                       Maint./Suppt Total   **$190,000/yr**

5. Supplies.
    A. 2 cases of paper (10 reams per case) per month per printer x 10 printers
       x 12 months @ $30 per case = $7,200/yr
       Source: Info World, 21 Mar 1998.

    B. 1 toner cartridge per printer per month x 10 printers x 12 months
       @$150/cartridge = $18,000/yr
       Source: Historical supply records, HP GSA price list, 1998.

    C. 2 boxes of 3.5" floppy disks (10 disks per box, MFD-2HD) per work
       station per year x 50 work stations @ 10.50/box = $1,050/yr
       Source: 3M GSA Price List, 1998.

    D. 4 back-up tapes (DC 2120) per work station per year x 50 workstations
       @ $3/tape = $600/yr
       Source: 3M GSA Price List, 1998.

                                         Supplies Total =   **$ 26,850/yr**

ALTERNATIVE 2: WORKGROUP SOLUTION

1. Hardware.
    A. 50 personal computer work stations (486DX2/50MHz CPU, 8 MB RAM,
        340 HD, SVGA Color Monitor, extended keyboard, mouse, pre-loaded
        Windows and DOS) @ $1,750 per work station = $87,500
        Source: Based on the average of 5 GSA vendor price lists.

    B. 10 laser printers (17ppm, 600 dpi, dual bins, transparency capability,
        envelope, label, and front/back printing) @ $6,500 per printer = $65,000
        Source: Black Box Catalog, Feb 1998.

    C. 50 Back-up Systems (250 MB, 1 per workstation) @ $130 per system $6,500
        Source: DataPro Catalog, Jan 1998.

    D. 50 Ethernet Network cards (16-bit ISA twisted-pair) @ $120/PC = $6,000
        Source: HP GSA price list, 1998.

    E. 10 Printer Network interface cards @ 110/card = $1,100
        Source: HP GSA price list, 1998.

    F. 5 Ethernet Network Hubs (12 twisted-pair ports, supports twisted-pair
        cascading, full 802.3 multiport repeater) = $10,000
        Source: HP GSA price list, 1998.

    G. 5 Patch Panels = $1,500
        Source: HP GSA price list, 1998.

    H. Cabling: Includes all materials associated (RJ-45 twisted pair cables
        and connectors) @ $150/drop x 60 drops = $9,000
        Source: Black Box Catalog, Feb 1994.

                                                   Hardware Total =   **$186,600**
2. Software.
    A. 50 Windows software applications packages, which includes word processor,
        spreadsheet, and graphics capabilities @ $750 per work station = $37,500
        Source: Based on the average of 5 software vendor GSA price lists.

    B. 100 software upgrades (2 upgrades per work station) @ $150 per upgrade = $15,000
        Source: Based on the average of 5 software vendor GSA price lists.

    C. Workgroup operating system software @ $160 per work station x 50 work
        stations = $8,000
        Source: LAN Times, Feb 1998.

                                                   Software Total =   **$60,500**

3. Installation.
    2,000 hours of labor @$20.00/hour (Washington D.C. area estimate) = $40,000
        Source: Survey of 5 D.C. area hardware installation firms.

                                              Installation Total =   **$40,000**

4. Maintenance/Support.
    A. PC Maintenance Contract: 1 year contract @ $325 per work station x 50 work
        stations (includes all parts and labor, on call 5 days a week) = $16,250/yr
        Source: Historical vendor contracts for maintenance.

    B. Printer Maintenance Contract: 1 year contract (includes all parts and
        labor, on call 5 days a week) @ $2,500/printer/year x 10 printers = $25,000/yr
        Source: Average of 5 current vendor maintenance contracts for laser printers.

    C. Support: 1 year contract (includes PC and printer trouble-shooting,
        hardware and software support, 40 hours a week) = $152,500/yr

        Source: Survey of 5 vendor support contracts for the Washington, D.C. area.

                                              Maint/Supp. Total =   **$193,750/yr**

5. Supplies.
    A. 2 cases of paper (10 reams per case) per month per printer x
        10 printers x 12 months @ $30 per case = $7,200/yr
        Source: Info World, Mar 1998.

    B. 1 toner cartridge per printer per month x 10 printers x 12
        months @ $150/cartridge = $18,000/yr
        Source: HP GSA price list, 1998.

    C. 2 boxes of 3.5" floppy disks (10 disks per box, MFD-2HD) per work
        station per year x 50 work stations @ 10.50/box = $1,050/yr
        Source: 3M GSA price list, 1998.

    D. 4 back-up tapes (DC 2120) per work station per year x 50
        workstations @ $3/tape = $600/yr
        Source: 3M GSA price list, 1998.

                                              Supplies Total =   **$26,850/yr**

2. ***Example Two***. The following is an example of a Class VI(a) system Economic Analysis. In addition to the elements included in a Class VI(b) system Economic Analysis, the Class VI(a) analysis also includes a cost sensitivity analysis as well.

However, because the status quo is not feasible in this example, SIR and DPP cannot be calculated. For an example using SIR, DPP, and EUAC calculations, please see appendix E.

PROJECT EXECUTIVE SUMMARY

Project Title: ULTIMA Financial Management System

Period of Analysis: 7 Years

Start Year: 1999

Project Objective: To provide Corps financial managers with a Windows interface to network analysis centers and the Corps financial management databases.

Assumptions:
1. The start year is 1999.
2. The real discount rate used in this analysis is 2.4%.
3. Lead time (period extending from the expenditure of funds to the complete deployment of the system) is two years.
4. The economic life of the alternatives is five years; thus, there are no residual values associated with the alternatives.
5. Personnel and workload are expected to remain constant over the period of analysis.
6. Software upgrades for the Commercial-Off-The-Shelf (COTS) Alternative is required in 2003.
7. All costs were derived and estimated in 1999 dollars.
8. All costs were included in the analysis to represent the total outlays and total net present values of each alternative.
9. Each package, if selected, will become the Corps standard.
10. All Corps employees have Windows installed on their computers.
11. A significant portion of the programming costs for the ULTIMA system will come from software enhancements, due to expected system expansion and capability upgrades.

Alternatives Considered:

1. *ULTIMA SYSTEM IN ADA:* The Corps would have a contractor design, implement, and maintain a financial management system called ULTIMA. Under this alternative, ULTIMA would be developed in Ada, and the government would own the code. The system would be able to interface with other information systems, as well as the various Corps databases. All enhancements, maintenance, support, and project administration would be provided by the contractor.

2. *COMMERCIAL-OFF-THE-SHELF SYSTEM:* A financial management software system would be purchased from the private sector and used as the Corps standard for financial management. The vendor's purchase price would include an unlimited site license for all Corps users. The Corps would, however, contract out to program the interfaces. A contractor would also provide all maintenance, support, and administration for the system.

3. *ULTIMA SYSTEM IN C++:* The Corps would have a private contractor design, implement, and maintain a financial management system called ULTIMA. Unlike the ULTIMA Ada alternative, however, the ULTIMA system would be developed in C++. The system would also be able to interface with other information systems, as well as the various Corps databases. All enhancements, maintenance, support, and

project administration would be provided by the contractor. The government would also own the code.

4.   *STATUS QUO:* Currently, every financial management department in the Corps has its own financial management system. There are about 70 different systems in use, but none are programmed for use in a Windows operating system. Because of the recent mandate by the Corps to convert all financial systems into a Windows format and to connect to the Corps financial management databases, the Status Quo option is not feasible.

Results and Recommendations:

€   *Net Present Value Results*

Alternative Name:	NPV
1. ULTIMA in Ada	$2,246,927
2. Commercial-Off-The-Shelf	$2,591,653
3. ULTIMA in C++	$2,642,885

€   *Non-Monetary Benefits*

The primary benefit of ULTIMA is that the government would own the code. This would allow the government to make any enhancements and adjustments to the system in a quick, responsive manner. The less time spent on making changes to the system equates to less down time.

€   *Cost Sensitivity Analysis Results*

1. In the first cost sensitivity analysis test, the cost of software enhancement in the ULTIMA Ada option (Alternative 1)was varied to see if a change of rankings would result between the ULTIMA Ada option and the ULTIMA C++ alternative (Alternative 3). The results show that for C++ alternative to be ranked least cost, the software maintenance cost must be increased by more than 42.07%. Since an increase of this amount in the software maintenance cost is unlikely, however, the ULTIMA Ada option is insensitive to changes in its software maintenance cost.

2. Similarly, the second sensitivity analysis tested the ULTIMA Ada software maintenance cost to see if a change in the rankings would result between the Ada option and the COTS (Alternative 2) option. The results show that for the COTS alternative to be ranked least cost, the software maintenance cost must be increased by more than 36.62%. The ULTIMA Ada option is insensitive to changes in its software maintenance cost.

€   *Recommendation*

Costs and benefits were analyzed over a 7-year period. Annual costs were discounted at a 2.5 percent rate, and then totalled to arrive at a net present value (NPV). The least-cost alternative is the ULTIMA Ada (Alternative 1), with a NPV of $2.25M.

The ULTIMA C++ ($2.64M) and the COTS ($2.59M) options are both $400K more than the ULTIMA Ada alternative, respectively. Thus, the government would need $390K more (in present value terms, invested at 2.5%) to finance the ULTIMA C++ alternative and $340K more for the COTS alternative.

Based on the NPV and cost sensitivity test results, the least-cost alternative to meet this requirement is the ULTIMA Ada option, and is recommended for funding. Moreover, the ULTIMA Ada alternative would provide the government the added benefit of owning the code, which will result in responsive changes to the system, less down time, and unlimited government distribution.

Action Officers: Mike Rho Sofft and Aye B. Em, Project Managers,   (123) 456-7890
Organization: HQUSACE

LIFE CYCLE COST REPORT
Calculation of Discount Factors:

CALCULATION OF DISCOUNT FACTORS WHEN i = 2.5%, USING MIDDLE-OF-YEAR DISCOUNTING CONVENTION		
Year n	$1/(1+i)^{n-.5} =$	Discount Factor
1	$1/(1.025)^{1-.5}$	.988
2	$1/(1.025)^{2-.5}$	.964
3	$1/(1.025)^{3-.5}$	.940
4	$1/(1.025)^{4-.5}$	.917
5	$1/(1.025)^{5-.5}$	.895
6	$1/(1.025)^{6-.5}$	.873
7	$1/(1.025)^{7-.5}$	.852

* Note: i = the 7-year, real discount rate (remember to use the real discount rate when using constant dollars) and a middle-of-year discounting convention is used because all costs are spread evenly over the year; however, if you are particularly averse to performing mathematical calculations, you can simply turn to Appendix C and use the discount factors listed in the "Middle Of Year Discount Factors" table.

Life Cycle Cost Reports:

	ALTERNATIVE 1: ULTIMA in Ada										
	Cost Elements (Actual $s)								Total Annual Outlays	Disc. Rate	NPV of Annual Outlays
Year	Software Develop.	Data Interf.	System Deploy.	Hotline Support	Software Mainten.	Software Enhance.	Database Mainten.	Project Admin.			
1999	800,000	35,000							835,000	.988	824,755
2000	200,000	35,000	150,000			37,679	12,000	4,500	439,179	.964	423,210
2001				6,500	5,300	102,542	6,000	3,200	123,542	.940	116,146
2002				6,500	5,300	102,542	6,000	3,200	123,542	.917	113,313
2003				6,500	5,300	272,753	6,000	3,200	293,753	.895	262,860
2004				6,500	5,300	272,753	6,000	3,200	293,753	.873	256,450
2005				6,500	5,300	272,753	6,000	3,200	293,753	.852	250,193
								Total Outlays =	2,402,522	Total NPV =	2,246,927

ALTERNATIVE 2: Commercial-Off-The-Shelf								Total Annual Outlays	Disc. Rate	NPV of Annual Outlays
Year	Cost Elements (Actual $s)									
	Acquis. Cost	Data Interf.	System Deploy.	Hotline Support	Software Maint.	Software Upgrades	Database Mainten.	Project Adm.			
1999	1798000	89,000							1,887,000	.988	1,863,846
2000		47,000	260,000				12,000	4,500	323,500	.964	311,737
2001				7,530	6,250		6,000	3,200	22,980	.940	21,604
2002				7,530	6,250		6,000	3,200	22,980	.917	21,078
2003				7,530	6,250	350,000	6,000	3,200	372,980	.895	333,375
2004				7,530	6,250		6,000	3,200	22,980	.873	20,062
2005				7,530	6,250		6,000	3,200	22,980	.852	19,571
								Total Outlays =	2,675,400	**Total NPV =**	2,591,653

ALTERNATIVE 3: ULTIMA in C++								Total Annual Outlays	Disc. Rate	NPV of Annual Outlays
Year	Cost Elements (Actual $s)									
	Software Develop.	Data Interf.	System Deploy.	Hotline Support	Software Mainten.	Software Enhance.	Database Mainten.	Project Adm.			
1999	950,000	42,000							992,000	.988	979,828
2000	225,000	42,000	150,000			45,677	12,000	4,500	479,177	.964	461,754
2001				6,500	5,980	115,000	6,000	3,200	136,680	.940	128,498
2002				6,500	5,980	115,000	6,000	3,200	136,680	.917	125,364
2003				6,500	5,980	340,000	6,000	3,200	361,680	.895	323,643
2004				6,500	5,980	340,000	6,000	3,200	361,680	.873	315,751
2005				6,500	5,980	340,000	6,000	3,200	361,680	.852	308,047
								Total Outlays =	2,829,577	**Total NPV =**	2,642,885

Cost Sensitivity Analysis:

1. Ada vs. C++: Software Enhancement for
    ALLOWABLE CHANGE . . . . 200.00 PERCENT
    This sensitivity analysis checks for the ULTIMA C++ option (Alternative 3) to be ranked least cost
    as a result of changes in Ada's software maintenance cost listed below:

ALTERNATIVE	EXPENSE ITEM
1 - ULTIMA Ada	Software Enhancement
3 - ULTIMA C++	** NOTHING CHANGED **

    The Ada Only Option's Software Maintenance expense item was allowed to vary from a value
    of 100% less than its input value to 200.00% more than its input value.

ALTERNATIVE	NET PRESENT VALUE
1 - ULTIMA Ada	$2,246,927
3 - ULTIMA C++	$2,642,885

    For the C++ option to be ranked least cost, the selected expense item must be increased by more
    than 42.07%.

2. Ada vs. COTS: Software Enhancement for
    ALLOWABLE CHANGE .... 200.00 PERCENT
    This sensitivity analysis checks for the COTS option (#2) to be ranked least cost as a result of
    changes in the Ada software maintenance cost listed below:

ALTERNATIVE	EXPENSE ITEM
1 - ULTIMA Ada	Software Enhancements
2 - Commercial Off-The-Shelf	** NOTHING CHANGED **

    The Ada Only option's Software Maintenance expense item was allowed to vary from a value of
    100% less than its input value to 200.00% more than its input value.

ALTERNATIVE	NET PRESENT VALUE
1 - ULTIMA Ada	$2,246,927
2 - Commercial Off-The-Shelf	$2,591,653

    For the COTS option to be ranked least cost, the selected expense item must be increased by
    more than 36.62%.

Source and Derivation of Costs:
   ALTERNATIVE 1: ULTIMA IN ADA

1. **Software Development.** 8 Programmers (@ $100,000/yr salary) x 15 mths = $1,000,000.

2. **Develop Data Interfaces.** Includes all work for Corps database interface capability. 1 Ada Programmer (@ 35,000/yr salary) x 2 years = $70,000.

3. **System Deployment.** Includes all loading, installation, materials, and hook-up for the Corps and other required points-of-contact. 1,000 workstations @ $150/workstation = $150,000.

4. **Hotline Support.** Flat-rate fee for limited hotline support: 3 minute max. for calls - installation problems, bugs, etc. Application features not covered.

5. **Software Maintenance.** Estimated number of hours for maintenance per year is 200. 200 x $27/hr (maint. rate) = $5,300.

6. **Software Enhancements.** Enhancements must be done to accommodate mandated functionality and Corps system expansion. Some enhancements are needed in deployment year 2000: 1 programmer @ $59,333/yr x 7.6 months = $37,679. Years 2001, 2002: 2 programmers ($59,333/yr each) x 10.37 months = $102,542. Years 2003-2005: 5 programmers ($59,333/yr each) x 11 months = $272,753.

7. **Database Maintenance.** Includes all trouble-shooting and database integration. Approx. 480 hrs. @ $25/hr = $12,000 for 1st year. Subsequent years: 240 hrs. @ $25/hr = $6,000.

8. **Project Administration.** Includes day-to-day administration of the system. Approx. 300 hours @ $15/hr = $4,500 for the 1st year. Subsequent years: 213 hours @ $15/hr = $3,200.

SOURCE: All Costs and Schedules taken from an average of 3 contractor estimates: Divine Software Developers, Technologies, Inc., and Systems-R-Us.

ALTERNATIVE 2: COMMERCIAL-OFF-THE-SHELF

1. **Acquisition Cost for FundCruncher, Plus.** Includes an unlimited site license for Corps use. The government does not own the code. $1,798,000.
   SOURCE: Average of 5 1999-2000 GSA price lists.

2. Data Interfaces. Includes all work for Corps database interface capability. 2 programmers @$44,500/yr each x 18.3 months = $136,000.
   SOURCE: Taken from an average of 3 contractor estimates: Divine Software Developers, Technologies, Inc., and Systems-R-Us.

3. **System Deployment.** Includes all loading, installation, materials, and hook-up for the Corps and other required points-of-contact. Also requires extra peripherals. 1000 workstations @ $260/workstation = $260,000. Deployment will be completed in 12 months.
   SOURCE: Taken from an average of 3 contractor estimates: Divine Software Developers, Technologies, Inc., and Systems-R-Us.

4. **Hotline Support.** Flat-rate fee for hotline support: No time limit for calls - installation problems, bugs, etc. Application features covered.
   SOURCE: MacroFirm's 1999-2000 GSA price list estimate.

5. **Software Maintenance.** Estimate number of hours per year is 196. $27/hr x 196 = $5,300.
   SOURCE: Taken from an average of 3 contractor estimates: Divine Software Developers, Technologies, Inc., and Systems-R-Us.

6. **Software Upgrades.** Upgrades needed to accommodate system expansion. Scheduled release date 2003. Purchase price = $350,000.
   SOURCE: MacroFirm's 1999-2000 GSA price list estimate.

7. **Database Maintenance.** Includes all trouble-shooting and database integration. Approx. 480 hrs. @ $25/hr = $12,000 for 1st year. Subsequent years: 240 hrs. @ $25/hr = $6,000.
   SOURCE: Taken from an average of 3 contractor estimates: Divine Software Developers, Technologies, Inc., and Systems-R-Us.

8. **Project Administration.** Includes day-to-day administration of the system. Approx. 300 hours @ $15/hr = $4,500 for the 1st year. Subsequent years: 213 hours @ $15/hr = $3,200.
   SOURCE: Taken from an average of 3 contractor estimates: Divine Software Developers, Technologies, Inc., and Systems-R-Us.

ALTERNATIVE 3: ULTIMA IN C++

1. **Software Development.** 8 C++ Programmers (@ $118,750,/yr salary) x 14.8 mths
    = $1,175,000.

2. **Data Interfaces.** Includes all work for Corps database interface capability. 1 C++ Programmer (@
    $42,000/yr salary) x 24 months = $84,000.

3. **System Deployment.** Includes all loading, installation, materials, and hook-up for the Corps and other
    required points-of-contact. 1000 workstations @ $150/workstation = $150,000.

4. **Hotline Support.** Flat-rate fee for limited hotline support: 3 minute max. for calls - installation
    problems, bugs, etc. Application features not covered.

5. **Software Maintenance.** Estimated number of hours for maintenance per year is 221. 221 x $27/hr
    (maint. rate) = $5,980.

6. **Software Enhancements.** Enhancements must be done to accommodate mandated functionality and
    Corps system expansion. Some enhancements are needed in deployment year 2000: 1 programmer
    @ $59,333/yr x 9.2 months = $45,677. Years 2001, 2002: 2 programmers ($59,333/yr each) x 11.6
    months = $115,000. Years 2003-2005: 6 programmers ($59,333/yr each) x 11.5 months = $340,000.

7. **Database Maintenance.** Includes all trouble-shooting and database integration. Approx. 480 hrs.
    @ $25/hr = $12,000 for 1st year. Subsequent years: 240 hrs. @ $25/hr = $6,000.

8. **Project Administration.** Includes day-to-day administration of the system. Approx. 300 hours
    @ $15/hr = $4,500 for the 1st year. Subsequent years: 213 hours @ $15/hr = $3,200.

    *SOURCE: All Costs and Schedules taken from an average of 3 contractor estimates: Divine Software
    Developers, Technologies, Inc., and Systems-R-Us.*

Source and Derivation of Costs

1. Hardware.
   A.   9 laser printers (17 ppm, 600 dpi, dual bins, transparency capability,
        envelope, label, and front/back printing) @ $6,500 per printer = $58,500
   B.   12 Laserboards (6 serial, 1 parallel input) @ $700 per Laserboard = $8,400
   C.   72 modular adapters (1 per each work station) @ $10.20 per adapter = $735
   D.   3,000 feet of modular cabling @ $.25/ft = $750
                                                      Hardware Total = $68,385

   Source: Black Box Catalog, February 1998.

2. Installation.
   240 hours of labor @ 15.00/hour (Washington D.C. area estimate) = $ 3,600
                                                      Installation Total = $ 3,600

   Source: Survey of 5 D.C. area hardware installation firms (Hardware Servicers,
   CompService, ProInstall, TechMasters, and Rp.U.Off and Sons).

3. Maintenance.
   1 year contract (includes all parts and labor; on call 5 days/week) @
   2,500/printer/year x 12 printers = $30,000
                                                      Maintenance Total = $30,000/yr

   Source: Average of 5 current vendor maintenance contracts for laser printers (Comp City, Graphics Corp, ProPrint, Hardware Plus).

4. Supplies.

   A.   2 cases of paper (10 reams per case) per month
        per printer x 12 printers x 12 months@ $30/case = $8,640
   B.   1 toner cartridge per printer per month
        x 12 printers x 12 months @ 100/cartridge = $14,400
                                                      Supplies Total = $23,040/yr

   Source: Prices derived from the previous 12 supply orders for the office.

Appendix A: References

Section I
Required Publications

AR 11-18
The Cost and Economic Analysis Program.

AR 25-3
Army Life Cycle Management of Information Systems

ER 25-1-2
Life Cycle Management of Information Systems

Section II
Related Publications

OMB Circular A-94
Discount Rates to be Used in Evaluating Time-Distributed Costs and Benefits

DODI 7041.3
Economic Analysis and Program Evaluation for Resource Management

DAPAM 11-2
Guide for Economic Analysis

DAPAM 25-2
Information Mission Area Planning Process

HQDA LOI
Letter of Instruction (LOI) for Performing Economic Analysis (EA) and Costing Requirements for Automated Information Systems (AIS)

Appendix B: Economic Analysis
Milestone Requirements

1.00   Research and Development (R&D)
   1.01   Development Engineering
   1.02   Producibility Engineering and Planning
   1.03   Tooling
   1.04   Prototyping
   1.05   Documentation/Data
   1.06   Test and Evaluation
   1.07   System/Project Management
   1.08   Developmental Training
   1.09   Facilities
   1.10   Software Development
   1.20   Hardware Development
   1.30   Developmental Logistical Support
   1.40   Other Development Costs

2.00   Production and Deployment (P&D)
   2.01   Hardware
   2.011   Processing Units
   2.0111 Central Processing Units
   2.0112 Intermediate Processing Units
   2.0113 Terminal Processing Units
   2.012   Peripheral Devices
   2.0121 Printers
   2.0122 Storage Devices
   2.0123 Other Peripheral Devices
   2.013   Communications Hardware
   2.0131 Wide-Area Gateways (Broad Band)
   2.0132 Wide Area Networks
   2.0133 Modems
   2.0134 Local Area Networks
   2.0135 CRYPTO
   2.0136 Other Communications Hardware
   2.014   Hardware Improvements and Upgrades
   2.0141 Pre-Planned Hardware Improvements
   2.0142 Hardware Upgrades
   2.015   Other Hardware
   2.02   Software
   2.021   Commercial-Off-The-Shelf(COTS)
   2.0211 Operating System Software
   2.0212 General Administrative Software
   2.022   Mission Specific Application Software
   2.0221 Contractor Developed Software
   2.0222 Organically Developed Software

2.023   Communication Software
2.0231 Wide-Area Gateways (Broad Band)
2.0232 Wide Area Networks
2.0233 Modems
2.0234 Local Area Networks
2.0235 CRYPTO
2.0236 Other Communications Hardware
2.024   Software Improvements and Upgrades
2.0241 Pre-Planned Software Improvements
2.0242 Software Upgrades
2.025   Other Software
2.03   Warranties
2.10   Non-Recurring Production
2.11   Initial Production Facilities
2.12   Production Base Support
2.20   Recurring Engineering
2.21   Manufacturing
2.22   Recurring Engineering
2.23   Sustaining Tooling
2.24   Quality Control
2.30   Military Construction
2.40   Deployment
2.410 Site Activation & Initial Base Support
2.411 Facilities Preparation
2.412 System Installation
2.413 Communications
2.414 Site Survey
2.415 Personnel Relocation
2.416 Environmental and HAZMAT
2.420 Total Package Fielding
2.421 Initial Repair Parts/Consumables
2.422 Initial Spares (Repairables)
2.423 Support Equipment
2.424 Other Fielding Costs
2.430 Transportation
2.431 First Destination
2.432 Second Destination
2.440 Training Services and Equipment
2.50   Modifications/SCPs/Test and Evaluation
2.51   System/Engineering Change Packages
2.52   Data
2.53   Test and Evaluation
2.54   Modifications

2.60   Program Management
2.70   Other Procurement Costs

3.0   Operations and Support

3.01	System/Project Management
3.02	Installation and Base Support
3.021	Utilities
3.022	Communications
3.023	Family Housing Assistance
3.024	Facilities Maintenance
3.025	All Other Base Operations Support
3.03	Maintenance
3.031	Hardware Maintenance
3.032	Software Maintenance
3.033	Depot Maintenance
3.034	Field Maintenance
3.04	Replacement Training
3.05	Leases
3.051	Hardware Leasing
3.052	Software Leasing
3.053	Facilities Leasing
3.054	Other Leases
3.06	Logistical Support
3.061	Operating Supplies
3.062	Fuel & POL
3.063	Replenishment Spares
3.064	Ammunition and Missile
3.07	Disposal and Terminated Services
3.071	Disposal of Equipment and Other
3.072	Environmental and HAZMAT
3.08	Second Destination Transportation
3.09	Parallel System Operations
3.10	War Reserve Spares and Parts
3.11	Operations
3.112	Operating Personnel
3.113	Functional Personnel
3.114	Maintenance
3.12	Permanent Change of Stations (PCS)
3.13	Documentation/Data
3.14	Other Operations and Support Costs

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

February 10, 1994

THE DIRECTOR

M-94-14

MEMORANDUM FOR THE HEADS OF DEPARTMENTS AND AGENCIES

FROM: Leon E. Panetta
               Director

SUBJECT: 1994 Discount Rates for OMB Circular No. A-94

On October 29, 1992, OMB issued a revision to OMB Circular
No. A-94, "Guidelines and Discount Rates for Benefit-Cost
Analysis of Federal Programs." The revision established new
discount rate guidelines for use in benefit-cost and other types
of economic analysis.

The revised Circular specifies certain discount rates that
will be updated annually when the interest rate and inflation
assumptions in the budget are changed. These discount rates are
found in Appendix C of the revised Circular. The attachment to
this memorandum is an update of Appendix C. It provides
discount rates that will be in effect for the period March,
1994, through February, 1995.

The rates presented in Appendix C do not apply to
regulatory analysis. They are to be used for lease-purchase and
cost-effectiveness analysis, as specified in the Circular.

Attachment

Appendix C: Discount Factors

APPENDIX C

DISCOUNT RATES FOR COST-EFFECTIVENESS, LEASE PURCHASE, AND RELATED ANALYSES

Effective Dates. This appendix is updated annually around the time of the President's budget submission to Congress. This version of the appendix is valid through the end of February, 1995. Updates of this appendix will be available upon request from the Office of Economic Policy in OMB (202-395-3381). Copies of the appendix and the Circular may also be obtained from the OMB Publications Office (202-395-7332).

Nominal Discount Rates. Nominal interest rates based on the economic assumptions from the budget are presented in the table below. These nominal rates are to be used for discounting nominal flows, as in lease-purchase analysis.

Nominal Interest Rates on Treasury Notes and Bonds of Specified Maturities (in percent)

3-Year	5-Year	7-Year	10-Year	30-Year
5.0	5.3	5.5	5.7	5.8

Analyses of programs with terms different from those presented above may use a linear interpolation. For example, a four-year project can be evaluated with a rate equal to the average of the three-year and five-year rates. Programs with durations longer than 30 years may use the 30-year interest rate.

Real Discount Rates. Real interest rates based on the economic assumptions from the budget are presented below. These real rates are to be used for discounting real (constant-dollar) flows, as in cost-effectiveness analysis.

Real Interest Rates on Treasury Notes and Bonds of Specified Maturities (in percent)

3-Year	5-Year	7-Year	10-Year	30-Year
2.1	2.3	2.5	2.7	2.8

Analyses of programs with terms different from those presented above may use a linear interpolation. For example, a four-year project can be evaluated with a rate equal to the average of the three-year and five-year rates. Programs with durations longer than 30 years may use the 30-year interest rate.

MIDDLE OF YEAR DISCOUNT FACTORS

YEAR	M-O-Y DISCOUNT FACTOR FOR A 5-6 YEAR PERIOD OF ANALYSIS	M-O-Y DISCOUNT FACTOR FOR A 7-8 YEAR PERIOD OF ANALYSIS	M-O-Y DISCOUNT FACTOR FOR A 9-10 YEAR PERIOD OF ANALYSIS
1	.989	.988	.987
2	.966	.964	.961
3	.945	.940	.936
4	.923	.917	.911
5	.903	.895	.887
6	.882	.873	.864
7	.863	.852	.841
8	.843	.831	.819
9	.824	.811	.797
10	.806	.791	.776

Appendix D: Inflation Indices

DACS-PBC   7 February 1994
PBC MEMO 94-012

MEMORANDUM FOR MEMBERS OF THE PROGRAM AND BUDGET COMMITTEE

SUBJECT: Revised Inflation Indices--Correction #2

1. References:
        a. PBC Memo 94-002, 6 JAN 1994, subject: Revised Inflation Indices--Corrected Copy.
        b. OSD memo, 4 JAN 1994, subject: Revised Inflation Guidance (Enclosure 1).
        c. PBC memo 93-24, 4 MAR 1993, subject: Revised Inflation Indices.
        d. Inflation and Real Growth Primer, OASA(FM), March 1993.

2. **Attached at Enclosure 2 are corrected inflation indices which replace those issued at Reference 1a. PBC memo 94-002 should be discarded.** Corrections have been made to escalation rates for FY 1982 through 1986, 1990, and 1992, with an impact on compound and composite indices for all appropriations. **FYs 1995 through 2010 remain unchanged from PBC Memo 94-002.**

3. The Army inflation indices have been revised in accordance with reference 1b, superseding those at reference 1c. These indices (Enclosure 2) have been derived from economic assumptions provided by OMB for use in developing the FY 1995 President's budget submission and supporting Congressional justification materials, and are to be used in the FY 1996-2001 Program Objective Memorandum and in the Selected Acquisition Reports (SARS) for December 1993. Note that the inflation indices at Enclosure 2 should be applied only to the **purchase (non-pay, non-fuel)** portions of Army accounts. Pay raise factors in reference 1b should be used to price the pay portion of Army accounts, and medical factors should be used to price pharmaceuticals and hospital services.

4. The Primer at reference 1d contains instructions regarding the usage of the enclosed indices. It remains unchanged from the March 1993 publication. Local reproduction of copies already in circulation is encouraged. Limited additional copies are available in Room 3B663 until exhausted--thereafter, a master will be available for reproduction.

5. Point of contact is Mr. Paul Potamianos, SAFM-BUC-F, Room 3B663, 697-6241.

FOR THE CHAIRMEN OF THE PROGRAM AND BUDGET COMMITTEE:

Enclosures   WESLEY C. MILLER
as   LTC, GS
                                                        Executive for Budgeting, PBC

COMPTROLLER OF THE DEPARTMENT OF DEFENSE

WASHINGTON, DC 20301-1100

JAN 4 1994

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
              CHAIRMAN OF THE JOINT CHIEFS OF STAFF
              UNDER SECRETARIES OF DEFENSE
              ASSISTANT SECRETARIES OF DEFENSE
              GENERAL COUNSEL
              INSPECTOR GENERAL
              DIRECTOR, OPERATIONAL TEST AND EVALUATION
              COMMANDER-IN-CHIEF, U.S. SPECIAL OPERATIONS
                COMMAND
              COMMANDER-IN-CHIEF, U.S. TRANSPORTATION COMMAND
              ASSISTANTS TO THE SECRETARY OF DEFENSE
              DIRECTORS OF THE DEFENSE AGENCIES
              DIRECTOR, WASHINGTON HEADQUARTERS SERVICES
              DIRECTOR, INTELLIGENCE COMMUNITY STAFF

SUBJECT: Revised Inflation Guidance

     The attached inflation and spendout rates supersede those
used in preparation of the September submission of the FY 1995
budget.

     These rates are to be reflected in the FY 1995 budget
submission and supporting congressional justification materials;
the FY 1996-FY 2001 Program Objective Memoranda (POM); and the
Selected Acquisition Reports (SARs) for December 1993 in
accordance with guidelines and procedures contained in DoD
Instruction 5000.2, "Defense Acquisition Management Policies and
Procedures," and DoD Manual 5000.2-M, "Defense Acquisition
Management Documentation and Reports."

Alice C. Maroni
Principal Deputy Comptroller

Attachment

PRICE ESCALATION INDICES
(Annual Rates in Percentages)

OUTLAYS

Fiscal Year	Procurement	RDTE	Mil Con FH Const	O&M (Excl Fuel)	O&M Fuel	Mil 1/ Pers Non-Pay	CPI-U Medical
1993	2.7	2.7	2.7	2.7	1.4	2.7	6.3
1994	2.5	2.5	2.5	2.5	14.1	2.5	5.1
1995	2.8	2.8	2.8	2.8	-12.4	2.8	5.2
1996	2.9	2.9	2.9	2.9	6.1	?.9	5.2
1997	3.0	3.0	3.0	3.0	6.1	3.0	5.0
1998	3.0	3.0	3.0	3.0	6.1	3.0	4.9
1999 3/	3.0	3.0	3.0	3.0	6.1	3.0	4.4

BUDGET AUTHORITY 2/

Fiscal Year	Procurement	RDTE	Mil Con FH Const	O&M (Excl Fuel)	O&M Fuel	Mil Pers Non-Pay	CPI-U Medical
1993	2.7	2.6	2.7	2.7	1.4	2.7	6.3
1994	2.8	2.7	2.7	2.6	14.1	2.5	5.1
1995	2.9	2.9	2.9	2.8	-12.4	2.8	5.2
1996	3.0	3.0	2.9	2.9	6.1	2.9	5.2
1997	3.0	3.0	3.0	3.0	6.1	3.0	5.0
1998	3.0	3.0	3.0	3.0	6.1	3.0	4.9
1999 3/	3.0	3.0	3.0	3.0	6.1	3.0	4.4

PAY RAISE ASSUMPTIONS 4/

	Military	Civilian
1993	3.7	3.7
1994	2.2	*
1995	1.6	1.6
1996	2.2	2.2
1997	2.5	2.5
1998	2.5	2.5
1999 3/	2.5	2.5

*   FY 1994 civilian pay raises average 3.6% for General Schedule personnel receiving locality pay and 2% for Wage Grade personnel.

1/   Not to be used to inflate accounts fixed by statute.

2/   These are composite rates at the title level. Inflation rates for specific accounts are a function of the spend out profiles and may vary within each title.

3/   These rates are to be used for all years beyond 1999.

4/   All pay raises effective January 1.

OUTLAY RATES TO BE USED FOR INCREMENTAL CHANGES IN BA PURCHASES
(as Percent of BA Purchases)

	FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURTH YEAR	FIFTH YEAR	SIXTH YEAR	SEVENTH YEAR
MILITARY PERSONNEL							
Mil Per-Army	70.45	29.55					
Mil Per-Navy	80.35	19.65					
Mil Per-MC	70.86	29.14					
Mil Per-Air Force	71.09	28.91					
Res Per-Army	74.78	25.22					
Res Per-Navy	50.96	49.04					
Res Per-MC	56.77	43.23					
Res Per-Air Force	70.22	29.78					
Nat Gd Per-Army	71.84	28.16					
Nat Gd Per-Air Force	68.75	31.25					
OPERATION AND MAINTENANCE							
O&M-Army	55.90	34.27	6.35	3.48			
O&M-Navy	53.38	39.63	4.45	2.54			
O&M-MC	59.88	31.34	4.86	3.92			
O&M-Air Force	56.86	33.91	5.04	4.19			
O&M-Def Wide	41.47	42.79	9.59	6.15			
O&M-Army Res	54.07	37.03	8.90				
O&M-Navy Res	40.90	48.32	10.78				
O&M-MC Res	67.76	25.57	6.67				
O&M-Air Force Res	49.10	39.95	10.95				
O&M-Army Nat Gd	61.43	30.68	7.89				
O&M-Air Nat Gd	55.03	37.51	7.46				
Inspector General	32.77	35.86	17.93	13.44			
Rifle Practice, Army	30.23	58.46	11.31				
Drug Interdiction	34.40	43.30	12.50	5.00	4.80		
Court of Mil Appeals	10.14	46.88	42.98				
Environ. Rest. Def	22.00	45.00	22.00	6.00	5.00		
Human. Asst	45.40	34.50	15.00	5.10			
Def. Health Program	80.70	14.05	2.57	1.83	0.86		
PROCUREMENT							
Army							
Aircraft	11.00	43.00	25.30	9.50	7.60	3.60	
Missiles	6.00	30.00	48.30	8.20	4.00	3.50	
W&TCV	2.00	41.50	37.00	10.50	5.30	3.70	
Ammunition	40.70	5.70	39.60	8.00	6.00		
Other Proc Army	9.70	32.50	28.30	16.70	6.80	6.00	
Defense Agencies/Defense Wide							
Procurement Def Wide	36.00	45.00	16.50	1.20	1.30		
Chem Agts & Mun Dest	42.00	33.00	16.00	4.00	3.00	2.00	
Nat Gd & Res Equip	5.00	31.00	31.00	15.50	7.00	10.50	

OUTLAY RATES TO BE USED FOR INCREMENTAL CHANGES IN BA PURCHASES
(as Percent of BA Purchases)

	FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURTH YEAR	FIFTH YEAR	SIXTH YEAR	SEVENTH YEAR
Navy							
Aircraft	13.50	32.10	31.70	13.20	4.60	4.90	
Weapons	9.70	32.80	38.20	10.00	4.50	4.80	
Shipbuilding & Conv	5.10	13.30	20.00	17.00	17.00	17.00	10.60
Other Proc Navy	10.90	22.00	36.40	17.30	7.80	5.60	
Procurement MC	15.70	24.30	26.50	21.50	7.50	4.50	
Air Force							
Aircraft	4.50	24.10	37.10	17.80	8.90	7.60	
Missiles	6.00	22.00	33.00	28.50	8.90	1.60	
Other Proc A F	46.70	25.09	16.88	7.15	2.65	1.53	
RDT&E							
RDT&E-Army	38.40	46.54	10.00	2.46	2.60		
RDT&E-Navy	47.73	38.80	9.06	1.51	2.90		
RDT&E-Air Force	43.54	40.95	9.39	3.80	2.32		
T&E-Def Wide	46.06	39.64	10.11	4.19			
T&E, Def	25.00	45.00	20.00	5.00	5.00		
Dir OT&E, Def	11.70	67.00	12.00	2.00	7.30		
MILITARY CONSTRUCTION							
Mil Con-Army	13.30	21.39	30.69	19.54	8.92	6.16	
Mil Con-Navy	7.10	53.14	25.65	7.05	4.49	2.57	
Mil Con-Air Force	19.90	53.10	20.30	4.20	1.50	1.00	
Mil Con-Def Wide	13.90	38.70	22.90	12.70	5.90	5.90	
Mil Con-Army Nat Gd	19.90	55.80	20.70	2.20	1.40		
Mil Con-Air Nat Gd	17.10	60.30	17.40	3.00	1.00	1.20	
Mil Con-Army Res	7.00	56.00	20.00	9.00	4.50	3.50	
Mil Con-Navy Res	22.70	58.40	17.60	0.80	0.50		
Mil Con-Air Force Res	21.50	58.00	19.80	0.40	0.30		
Base Closure	12.00	35.00	24.00	15.00	7.00	7.00	
NATO Infrastructure	25.00	20.00	20.00	15.00	15.00	5.00	
FAMILY HOUSING							
Construction-Army	14.00	36.90	23.40	14.90	6.80	4.00	
Construction-Navy	11.00	38.00	26.00	15.00	5.00	5.00	
Construction-Air Force	13.00	44.00	26.00	7.00	5.00	5.00	
Construction-Def Wide	85.00	11.00	2.00	2.00			
Ops & Debt-Army	78.61	17.11	2.67	1.61			
Ops & Debt-Navy	62.77	28.68	5.84	2.71			
Ops & Debt-A F	71.75	22.70	4.34	1.21			
Ops & Debt-Def Wide	71.00	17.00	12.00				

Appendix E: Example PC ECONPACK Reports

PC ECONPACK is a unique economic analysis computer package available to engineers, economists, master planners, accountants, project managers, and other personnel throughout the Department of Defense (DoD). PC ECONPACK is a comprehensive program incorporating economic analysis calculations, documentation, and reporting capabilities.

It is structured so it can be used by non-economists to prepare complete, properly documented economic analyses (EAs) in support of DoD funding requests. PC ECONPACK is menu-driven and features interactive display screens which enable the user to select analysis parameters and specify functions. The user simply enters in the information, and PC ECONPACK does the rest.

PC ECONPACK's analytic capabilities are generic, providing standardized economic analysis methodologies and calculations to evaluate a broad range of capital investment categories such as barracks, hospitals, family housing, information systems, utility plants, maintenance facilities, ranges, runways, and equipment. The program performs standardized life-cycle cost calculations such as **net present value, equivalent uniform annual cost, savings-to-investment ratio, and discounted payback period.**

Cost sensitivity analysis and **discount rate sensitivity analysis** features and **graphics capabilities** are also provided by the program. Text entry is permitted for the discussion of assumptions, alternative definitions, cost derivations, results and recommendations, and non-monetary benefits. The output reports conform to current DoD guidance.

PC ECONPACK was developed by the Construction Engineering Research laboratory (USACERL) under the sponsorship of Headquarters, U.S. Army Corps of Engineers (HQUSACE). Further information about the system can be obtained from:

Ms. Beth Baden, HQUSACE (CEMP-MC), (202) 272-8919, DSN 285-8919

Mr. Todd Omura HQUSACE (CEMP-MC), (202) 272-8918, DSN 285-8918

```
                                        FILENAME:    ULTIMA
                                        DATE GENERATED: 28 AUG 1994
                                        TIME GENERATED: 14:06:53
                                        VERSION: PC V4.0

              E X E C U T I V E   S U M M A R Y   R E P O R T        PAGE 001

PROJECT TITLE     : ULTIMA
DISCOUNT RATE     : 2.50%
PERIOD OF ANALYSIS:  7 YEARS
START YEAR        : 1999
BASE YEAR         : 1999

PROJECT OBJECTIVE : To provide Corps financial managers with the
                    capability to connect to network analysis centers
                    and the Corps financial management databases.

ALTERNATIVES CONSIDERED FOR THIS ANALYSIS:

1.   STATUS QUO: 70 DIFFERENT SYSTEMS:  Currently, every financial
management department in the Corps has its own financial management
system.  There are about 70 different Windows systems in use, but none
are programmed to interface with network analysis centers or Corps
databases.  All transferring, processing, and storage of data is
done by a team of contractors who first collect the needed data from
each system, and then process it themselves.

2.   ULTIMA SYSTEM IN ADA:  The Corps would have a contractor design,
implement, and maintain a financial management system called ULTIMA.
Under this alternative, ULTIMA would be developed in Ada, and the
government would own the code.  The system would be able to interface
with other information systems, as well as the various Corps databases.
All enhancements, maintenance, support, and project administration
would be provided by the contractor.

3.   COMMERCIAL-OFF-THE-SHELF SYSTEM:  A financial management
software system would be purchased from the private sector and used
as the Corps standard for financial management.  The vendor's
purchase price would include an unlimited site license for all
Corps users.  The Corps would, however, contract out to program the
interfaces.  A contractor would also provide all maintenance,
support, and administration for the system.

4.   ULTIMA SYSTEM IN C++:  The Corps would have a private
contractor design, implement, and maintain a financial management
system called ULTIMA.  Unlike the ULTIMA Ada alternative, however,
the ULTIMA system would be developed in C++.  The system would also
be able to interface with other information systems, as well as the
various Corps databases.  All enhancements, maintenance, support,
and project administration would be provided by the contractor.
The government would also own the code.


ASSUMPTIONS OF THE ANALYSIS:

1.  The start year is 1999.
```

E X E C U T I V E   S U M M A R Y   R E P O R T   PAGE 002

ASSUMPTIONS OF THE ANALYSIS (cont.):

2. The real discount rate used in this analysis is 2.4%.

3. Lead time (period extending from the expenditure of funds to the complete deployment of the system) is two years.

4. The economic life of the alternatives is five years; thus, there are no residual values associated with the alternatives.

5. Personnel and workload are expected to remain constant over the period of analysis.

6. Software application upgrades for the Commercial-Off-The-Shelf (COTS) Alternative is required in the year 2003.

7. All costs were derived and estimated in 1999 dollars.

8. All costs were included in the analysis to represent the total outlays and total net present values of each alternative.

9. Each package, if selected, will become the Corps standard.

10. All Corps employees have Windows installed on their computers.

11. A significant portion of the programming costs for the ULTIMA system will come from software enhancements, due to expected system expansion and capability upgrades.

RESULTS AND RECOMMENDATIONS:

```
   ALTERNATIVE NAME          NPV             EUAC          SIR      DPP
----------------------- --------------- --------------- ------ ----------
 1 Status Quo: 70 Diffe   $4,103,806       $638,399
 2 ULTIMA in Ada          $2,246,927       $349,537      2.55   2.0 YEARS
 3 Commercial Off-The-S   $2,591,653       $403,164      1.61   4.2 YEARS
 4 ULTIMA in C++          $2,642,885       $411,134      2.06   2.4 YEARS
```

NON-MONETARY BENEFITS:

    The primary benefit of ULTIMA is that the government would own the code. This would allow the government to make any enhancements and adjustments to the system in a quick, responsive manner. The less time spent on making changes to the system equates to less down time.

DISCUSSION:

    Costs and benefits were analyzed over a 7-year period. Annual costs were discounted at a 2.5 percent rate, and then totalled to arrive at a net present value (NPV). The least-cost alternative is the ULTIMA Ada (Alternative 2), with a NPV of $2.25M, a savings-to-investment ratio (SIR) of 2.55, and a discounted payback period (DPP) of 2.0 years.

    The ULTIMA C++ option ($2.64M), the COTS ($2.59M) option, and the

```
          E X E C U T I V E   S U M M A R Y   R E P O R T      PAGE 003
```

DISCUSSION (cont.):

Status Quo ($4.10M) are $390K, $334K, and $1.85M more than the ULTIMA Ada
alternative, respectively. Thus, the government would need $390K more
(in present value terms, invested at 2.5%) to finance the ULTIMA C++
alternative, $334K more for the COTS alternative, and $1.85M more for
the Status Quo.

     In the first cost sensitivity analysis test, the cost of Ada
software enhancements was varied to see if a change of rankings would
result between the Ada option (#2) and the C++ option (#4). The
results show that for the C++ alternative to be ranked least cost, the
Ada software enhancements cost must increase by more than 42.07%.
Since this is unlikely, the ULTIMA Ada option is insensitive to
changes in the software enhancements cost.

     Similarly, the cost of Ada software enhancements was varied to see
if a change of rankings would result between the Ada option (#2) and
the COTS option (#3). For the COTS option to be ranked least cost,
the Ada software enhancements cost must increase by more than 36.62%.
Once again, the Ada option is insensitive to changes in this cost.

     A discount rate sensitivity analysis was performed as well,
varying the discount rate from 1.88 to 3.13 percent. The rankings
remained the same throughout the range, with ULTIMA Ada being the
least cost alternative.

     Based on the NPV, SIR, DPP, and sensitivity test results, the least-cost
alternative to meet this requirement is the ULTIMA Ada option, and is
recommended for funding. Moreover, the ULTIMA Ada alternative would provide
the government the added benefit of owning the code, which will result in
responsive changes to the system, less down time, and unlimited government
distribution.

ACTION OFFICER: Howe Y. E, Project Manager, (123) 456-7890
ORGANIZATION : HQUSACE

```
              E C O N O M I C   A N A L Y S I S   G R A P H   1

                          CUMULATIVE NET PRESENT VALUE

              =+=========+=========+=========+=========+=========+=========+=
        4110 -                                                              1-
             I                                                         11 I
             I                                                        1   I
             I                                                       11   I
        3762 -                                                     11     -
             I                                                    1       I
             I                                                   11       I
             I                                                  1         I
   T    3414 -                                                11         -
   H         I                                               1           I
   O         I                                              11           I
   U         I                                             11            I
   S    3066 -                                            1              -
   A         I                                          11               I
   N         I                                         1                 I
   D         I                                        11                 I
   S    2718 -                                       1                   -
             I                                      11              3MMI
             I                                     1     3333333333333333MM4 I
   O         I                                   11    333               I
   F    2370 -                                1   33           444        -
             I                              11  333              444      2I
             I               33333333333333333M3333         44        222 I
   D         I            333           11              444         2222   I
   O    2022 -      333            1              444         222          -
   L         I 333               11            44         2222            I
   L         I3                 1            444       222                I
   A         I                11          444       222                  I
   R    1674 -              1      444444       2222                     -
   S         I            11  4444444      222                           I
             I           44M444         2222                             I
             I        444 1      22222222                                I
        1326 -       44  1122222222                                      -
             I     44   2M22                                             I
             I   44   2M1                                                I
             I 44   221                                                  I
         978 -4  2211                                                    -
             I 22 1                                                      I
             I2  1                                                       I
             I 11                                                        I
         630 -1                                                          -
              =+=========+=========+=========+=========+=========+=========+=
             1999      2000      2001      2002      2003      2004      2005

                                      YEAR

              LEGEND   DESCRIPTION              LEGEND   DESCRIPTION
              ------   -----------              ------   -----------
              1        Status Quo: 70 Diffe     M        MERGING DATA
              2        ULTIMA in Ada
              3        Commercial Off-The-S
              4        ULTIMA in C++
```

4-E-5

```
              S I R   E C O N O M I C   A N A L Y S I S  G R A P H   1

                                SIR VS. YEARS

          =+=========+=========+=========+=========+=========+=========+=
     2.55 -                                                           22-
          I                                                      22  I
          I                                                    22    I
          I                                                  222     I
   S 2.32 -                                                22        -
   A      I                                             22          I
   V      I                                           222           I
   N      I                                         22              I
   G 2.09 -                                       22                -
   N      I                                     22              444I
   G      I                                  222             4444  I
   S      I                                22             444       I
          I                              22            444          I
   / 1.86 -                            22           444            -
          I                          22         4444               I
   I      I                        2        444                    I
   N      I                      22      444                       I
   V 1.63 -                    2      444                        3-
   E      I                  22    4444                      333 I
   S      I                 2     44                      33     I
   T      I               22    44                     333       I
   M 1.40 -              2     4                     333         -
   E      I            22    44                   33            I
   N      I           2     44                 333             I
   T      I          2     4                 333              I
     1.17 -        22    44               33                -
          I        2    44             333                  I
   R      I       22   4             33                     I
   A      I------------2---44---------------333--------------------------I
   T  .94 -         2  44            33                    -
   I      I       2 44            333                      I
   O      I      22 4           33                         I
          I     2  4         333                          I
      .71 -    2 44         33                            -
          I    2 4       333                             I
          I 2244       33                                I
          I2 4      333                                  I
      .48 -44      33                                   -
          I      333                                    I
          I    33                                       I
          I  33                                         I
      .25 -33                                           -
          =+=========+=========+=========+=========+=========+=========+=
          1999      2000      2001      2002      2003      2004      2005

                                    YEAR


             LEGEND    DESCRIPTION
             ------    -----------
             2         ULTIMA in Ada
             3         Commercial Off-The-S
             4         ULTIMA in C++
```

```
              L I F E   C Y C L E   C O S T   R E P O R T         PAGE 001

ALTERNATIVE  1: Status Quo: 70 Different Systems

           Database        Project       Operations        TOTAL        MIDDLE
           Maintenance     Admin.         Support           ANNUAL       OF YEAR
YEAR                                                        OUTLAYS      DISCOUNT
           (01)            (02)           (03)                           FACTORS
----    -------------   -------------   -------------   -------------   -------------
1999        $12,000          $6,400        $620,000        $638,400        0.988
2000        $12,000          $6,400        $620,000        $638,400        0.964
2001        $12,000          $6,400        $620,000        $638,400        0.940
2002        $12,000          $6,400        $620,000        $638,400        0.917
2003        $12,000          $6,400        $620,000        $638,400        0.895
2004        $12,000          $6,400        $620,000        $638,400        0.873
2005        $12,000          $6,400        $620,000        $638,400        0.852
        -------------   -------------   -------------
%NPV           1.88            1.00           97.12
            $77,140         $41,140      $3,985,526
DISCOUNTING
CONVENTION    M-O-Y           M-O-Y           M-O-Y

                          CUMULATIVE
           PRESENT        NET PRESENT
YEAR        VALUE           VALUE

----    -------------   -------------
1999       $630,566        $630,566
2000       $615,187      $1,245,753
2001       $600,183      $1,845,936
2002       $585,543      $2,431,479
2003       $571,262      $3,002,741
2004       $557,329      $3,560,070
2005       $543,736      $4,103,806

EQUIVALENT UNIFORM ANNUAL COST = $638,399 (2.50% DISCOUNT RATE,  7 YEARS)
```

```
            L I F E   C Y C L E   C O S T   R E P O R T        PAGE 002

ALTERNATIVE  2: ULTIMA in Ada

           Software        Develop        System        Hotline       Software
           Development     Data           Deployment     Support       Maintenance
YEAR                       Interfaces
           (01)            (02)           (03)           (04)          (05)
----       -------------   -------------  -------------  ------------- -------------
1999        $800,000        $35,000             $0             $0            $0
2000        $200,000        $35,000       $150,000             $0            $0
2001              $0             $0             $0         $6,500        $5,300
2002              $0             $0             $0         $6,500        $5,300
2003              $0             $0             $0         $6,500        $5,300
2004              $0             $0             $0         $6,500        $5,300
2005              $0             $0             $0         $6,500        $5,300
           -------------   -------------  -------------  ------------- -------------
%NPV           43.74           3.04           6.43           1.30          1.06
            $982,912        $68,298       $144,546        $29,100       $23,728
DISCOUNTING
CONVENTION    M-O-Y          M-O-Y          M-O-Y          M-O-Y         M-O-Y

           Software        Database       Project        TOTAL         MIDDLE
           Enhancements    Maintenance    Admin.         ANNUAL        OF YEAR
YEAR                                                     OUTLAYS       DISCOUNT
           (06)            (07)           (08)                         FACTORS
----       -------------   -------------  -------------  ------------- -------------
1999              $0             $0             $0       $835,000         0.988
2000         $37,679        $12,000         $4,500       $439,179         0.964
2001        $102,542         $6,000         $3,200       $123,542         0.940
2002        $102,542         $6,000         $3,200       $123,542         0.917
2003        $272,753         $6,000         $3,200       $293,753         0.895
2004        $272,753         $6,000         $3,200       $293,753         0.873
2005        $272,753         $6,000         $3,200       $293,753         0.852
           -------------   -------------  -------------
%NPV           41.89           1.71           0.83
            $941,257        $38,425        $18,661
DISCOUNTING
CONVENTION    M-O-Y          M-O-Y          M-O-Y
```

```
         L I F E   C Y C L E   C O S T   R E P O R T           PAGE 003

ALTERNATIVE  2: ULTIMA in Ada

                         CUMULATIVE
            PRESENT     NET PRESENT
YEAR         VALUE         VALUE

----    -------------   -------------
1999        $824,755        $824,755
2000        $423,210      $1,247,965
2001        $116,146      $1,364,111
2002        $113,313      $1,477,424
2003        $262,860      $1,740,284
2004        $256,450      $1,996,734
2005        $250,193      $2,246,927

EQUIVALENT UNIFORM ANNUAL COST = $349,537 (2.50% DISCOUNT RATE,  7 YEARS)
```

```
             L I F E   C Y C L E   C O S T   R E P O R T          PAGE 004

                            PRIMARY ECONOMIC ANALYSIS

Present Alternative:        Status Quo: 70 Diffe
Proposed Alternative:       ULTIMA in Ada

                 Recurring Annual                        Present
                 Operating Costs                Present  Value of
Project   Present         Proposed    Differential  Value   Differential
Year(s)   Alternative     Alternative Cost       Factor  Cost
-------   -----------     ----------- ------------  -------  ------------
  1999    $638,400             $0     $638,400    0.988     $630,566
  2000    $638,400        $54,179     $584,221    0.964     $562,978
  2001    $638,400       $123,542     $514,858    0.940     $484,037
  2002    $638,400       $123,542     $514,858    0.917     $472,230
  2003    $638,400       $293,753     $344,647    0.895     $308,402
  2004    $638,400       $293,753     $344,647    0.873     $300,879
  2005    $638,400       $293,753     $344,647    0.852     $293,543
          -----------     ----------- ------------           ------------
Totals    $4,468,800    $1,182,522   $3,286,278             $3,052,635

Total present value of investment                          $1,195,756
Plus: present value of existing assets to be used                 $0
Less: present value of existing assets replaced                   $0
Less: present value of terminal value of alternative              $0
Total present value of net investment                      $1,195,756

Total present value of differential costs                  $3,052,635
Plus: present value of cost of refurbishment or
      modification eliminated                                     $0
Less: status quo salvage value                                    $0
Total present value of savings                             $3,052,635

Savings/Investment ratio                                        2.55
Discounted Payback Period                                  2.0 years

For Status Quo

Recurring Costs - Expense Item(s)  1  2  3

For Proposed Alternative

Recurring Costs - Expense Item(s)  4  5  6  7  8
Investment Costs - Expense Item(s)  1  2  3
```

```
          L I F E   C Y C L E   C O S T   R E P O R T         PAGE 005

ALTERNATIVE  3: Commercial Off-The-Shelf Package (COTS)

          Acquisition    Develop Data     System        Hotline       Software
            Cost          Interfaces     Deployment      Support      Maintenance
YEAR
            (01)            (02)            (03)          (04)           (05)
----     -------------   -------------   -------------  -------------  -------------
1999      $1,798,000       $89,000            $0            $0             $0
2000          $0           $47,000        $260,000          $0             $0
2001          $0              $0              $0         $7,530         $6,250
2002          $0              $0              $0         $7,530         $6,250
2003          $0              $0              $0         $7,530         $6,250
2004          $0              $0              $0         $7,530         $6,250
2005          $0              $0              $0         $7,530         $6,250
         -------------   -------------   -------------  -------------  -------------
%NPV         68.53           5.14            9.67          1.30           1.08
          $1,775,938      $133,199        $250,546       $33,711        $27,981
DISCOUNTING
CONVENTION    M-O-Y          M-O-Y           M-O-Y         M-O-Y          M-O-Y

           Database        Project        Software        TOTAL         MIDDLE
          Maintenance      Admin.         Upgrades        ANNUAL        OF YEAR
YEAR                                                      OUTLAYS       DISCOUNT
            (06)            (07)            (08)                         FACTORS
----     -------------   -------------   -------------  -------------  -------------
1999          $0              $0              $0         $1,887,000       0.988
2000       $12,000         $4,500            $0           $323,500       0.964
2001        $6,000         $3,200            $0            $22,980       0.940
2002        $6,000         $3,200            $0            $22,980       0.917
2003        $6,000         $3,200        $350,000         $372,980       0.895
2004        $6,000         $3,200            $0            $22,980       0.873
2005        $6,000         $3,200            $0            $22,980       0.852
         -------------   -------------   -------------
%NPV         1.48            0.72           12.08
           $38,425         $18,661        $313,192
DISCOUNTING
CONVENTION    M-O-Y          M-O-Y           M-O-Y
```

```
          L I F E   C Y C L E   C O S T   R E P O R T        PAGE 006

ALTERNATIVE  3: Commercial Off-The-Shelf Package (COTS)

                         CUMULATIVE
             PRESENT     NET PRESENT
YEAR         VALUE         VALUE

----      -------------  -------------
1999      $1,863,846     $1,863,846
2000        $311,737     $2,175,583
2001         $21,604     $2,197,187
2002         $21,078     $2,218,265
2003        $333,755     $2,552,020
2004         $20,062     $2,572,082
2005         $19,571     $2,591,653

EQUIVALENT UNIFORM ANNUAL COST = $403,164 (2.50% DISCOUNT RATE,  7 YEARS)
```

```
          L I F E   C Y C L E   C O S T   R E P O R T         PAGE 007

                         PRIMARY ECONOMIC ANALYSIS

Present Alternative:        Status Quo: 70 Diffe
Proposed Alternative:       Commercial Off-The-Shelf Package (COTS)

                 Recurring Annual                         Present
                 Operating Costs                 Present  Value of
Project   Present        Proposed     Differential Value   Differential
Year(s)   Alternative    Alternative  Cost         Factor  Cost
-------   -----------    -----------  ------------ -------  ------------
  1999     $638,400              $0    $638,400     0.988     $630,566
  2000     $638,400         $16,500    $621,900     0.964     $599,287
  2001     $638,400         $22,980    $615,420     0.940     $578,579
  2002     $638,400         $22,980    $615,420     0.917     $564,465
  2003     $638,400         $22,980    $615,420     0.895     $550,699
  2004     $638,400         $22,980    $615,420     0.873     $537,267
  2005     $638,400         $22,980    $615,420     0.852     $524,165
           -----------    -----------  ------------           ------------
Totals    $4,468,800       $131,400   $4,337,400             $3,985,028

Total present value of investment                           $2,472,875
Plus: present value of existing assets to be used                   $0
Less: present value of existing assets replaced                     $0
Less: present value of terminal value of alternative                $0
Total present value of net investment                       $2,472,875

Total present value of differential costs                   $3,985,028
Plus: present value of cost of refurbishment or
     modification eliminated                                        $0
Less: status quo salvage value                                      $0
Total present value of savings                              $3,985,028

Savings/Investment ratio                                          1.61
Discounted Payback Period                                    4.2 years

For Status Quo

Recurring Costs - Expense Item(s)  1  2  3

For Proposed Alternative

Recurring Costs - Expense Item(s)  4  5  6  7
Investment Costs - Expense Item(s)  1  2  3  8
```

```
        L I F E   C Y C L E   C O S T   R E P O R T        PAGE 008

ALTERNATIVE  4: ULTIMA in C++
```

YEAR	Software Development (01)	Develop Data Interfaces (02)	System Deployment (03)	Hotline Support (04)	Software Maintenance (05)
1999	$950,000	$42,000	$0	$0	$0
2000	$225,000	$42,000	$150,000	$0	$0
2001	$0	$0	$0	$6,500	$5,980
2002	$0	$0	$0	$6,500	$5,980
2003	$0	$0	$0	$6,500	$5,980
2004	$0	$0	$0	$6,500	$5,980
2005	$0	$0	$0	$6,500	$5,980
%NPV	43.71	3.10	5.47	1.10	1.01
	$1,155,162	$81,958	$144,546	$29,100	$26,772
DISCOUNTING CONVENTION	M-O-Y	M-O-Y	M-O-Y	M-O-Y	M-O-Y

YEAR	Software Enhancements (06)	Database Maintenance (07)	Project Admin. (08)	TOTAL ANNUAL OUTLAYS	MIDDLE OF YEAR DISCOUNT FACTORS
1999	$0	$0	$0	$992,000	0.988
2000	$45,677	$12,000	$4,500	$479,177	0.964
2001	$115,000	$6,000	$3,200	$136,680	0.940
2002	$115,000	$6,000	$3,200	$136,680	0.917
2003	$340,000	$6,000	$3,200	$361,680	0.895
2004	$340,000	$6,000	$3,200	$361,680	0.873
2005	$340,000	$6,000	$3,200	$361,680	0.852
%NPV	43.45	1.45	0.71		
	$1,148,261	$38,425	$18,661		
DISCOUNTING CONVENTION	M-O-Y	M-O-Y	M-O-Y		

```
        L I F E   C Y C L E   C O S T   R E P O R T        PAGE 009

ALTERNATIVE  4: ULTIMA in C++

                          CUMULATIVE
            PRESENT      NET PRESENT
YEAR        VALUE          VALUE

----      -------------  -------------
1999        $979,828       $979,828
2000        $461,754     $1,441,582
2001        $128,498     $1,570,080
2002        $125,364     $1,695,444
2003        $323,643     $2,019,087
2004        $315,751     $2,334,838
2005        $308,047     $2,642,885

EQUIVALENT UNIFORM ANNUAL COST = $411,134 (2.50% DISCOUNT RATE,  7 YEARS)
```

```
              L I F E   C Y C L E   C O S T   R E P O R T          PAGE 010

                          PRIMARY ECONOMIC ANALYSIS

Present Alternative:        Status Quo: 70 Diffe
Proposed Alternative:       ULTIMA in C++

                  Recurring Annual                        Present
                  Operating Costs               Present   Value of
Project   Present       Proposed      Differential  Value     Differential
Year(s)   Alternative   Alternative   Cost          Factor    Cost
-------   -----------   -----------   ------------  -------   ------------
  1999     $638,400           $0       $638,400     0.988      $630,566
  2000     $638,400      $62,177       $576,223     0.964      $555,271
  2001     $638,400     $136,680       $501,720     0.940      $471,685
  2002     $638,400     $136,680       $501,720     0.917      $460,179
  2003     $638,400     $361,680       $276,720     0.895      $247,619
  2004     $638,400     $361,680       $276,720     0.873      $241,578
  2005     $638,400     $361,680       $276,720     0.852      $235,689
           -----------   -----------   ------------            ------------
Totals    $4,468,800    $1,420,577    $3,048,223             $2,842,587

Total present value of investment                           $1,381,666
Plus: present value of existing assets to be used                   $0
Less: present value of existing assets replaced                     $0
Less: present value of terminal value of alternative                $0
Total present value of net investment                       $1,381,666

Total present value of differential costs                   $2,842,587
Plus: present value of cost of refurbishment or
      modification eliminated                                       $0
Less: status quo salvage value                                      $0
Total present value of savings                              $2,842,587

Savings/Investment ratio                                          2.06
Discounted Payback Period                                   2.4 years

For Status Quo

Recurring Costs - Expense Item(s)  1  2  3

For Proposed Alternative

Recurring Costs - Expense Item(s)  4  5  6  7  8
Investment Costs - Expense Item(s)  1  2  3
```

```
        L I F E   C Y C L E   C O S T   R E P O R T        PAGE 011
```

SOURCE AND DERIVATION OF COSTS AND BENEFITS:

STATUS QUO: 70 DIFFERENT SYSTEMS

1. Database Maintenance. Includes all trouble-shooting and database
integration. Approx. 480 hrs.per year @ $25/hr = $12,000/yr.

2. Project Administration. Includes day-to-day admininstration of
the current operations. Approx. 427 hrs/yr @ $15/hr = $6,400/yr.

3. Operations Support. Includes all transferring and relaying of
data into the databases; all organization and retrieval of data files;
all upkeep and trouble-shooting of system. 8 programmers @ $65,000/yr
+ 2 technicians @ $50,000/yr = $620,000/yr.

SOURCE: Pro Data Processors, 1998-1999 contract.

ALTERNATIVE 2: ULTIMA IN ADA

1. Software Development. 8 Programmers (@ $100,000/yr salary) x 15 mths =
$1,000,000.

2. Develop Data Interfaces. Includes all work for Corps database interface
capability. 1 Ada Programmer (@ 35,000/yr salary) x 2 years = $70,000.

3. System Deployment. Includes all loading, installation, materials, and
hook-up for the Corps and other required points-of-contact. 1,000 workstations
$150/workstation = $150,000.

4. Hotline Support. Flat-rate fee for limited hotline support: 3 minute max.
for calls - installation problems, bugs, etc. Application features not
covered.

5. Software Maintenance. Estimated number of hours for maintenance per year
is200. 200 x $27/hr (maint. rate) = $5,300.

6. Software Enhancements. Enhancements must be done to accommodate mandated
functionality and Corps system expansion. Some enhancements are needed in
deployment year 2000: 1 programmer @ $59,333/yr x 7.6 months = $37,679. Years
2001, 2002: 2 programmers ($59,333/yr each) x 10.37 months = $102,542. Years
2003-2005: 5 programmers ($59,333/yr each) x 11 months = $272,753.

7. Database Maintenance. Includes all trouble-shooting and database
integration. Approx. 480 hrs. @ $25/hr = $12,000 for 1st year. Subsequent
years: 240 hrs. @ $25/hr = $6,000.

8. Project Administration. Includes day-to-day administration of the system.
Approx. 300 hours @ $15/hr = $4,500 for the 1st year. Subsequent years: 213
hours @ $15/hr = $3,200.

SOURCE: All Costs and Schedules taken from an average of 3 contractor
estimates: Divine Software Developers, Technologies, Inc., and
Systems-R-Us.

```
           L I F E   C Y C L E   C O S T   R E P O R T        PAGE 012
```

SOURCE AND DERIVATION OF COSTS AND BENEFITS (cont.):

ALTERNATIVE 3: COMMERCIAL-OFF-THE-SHELF

1. Acquisition Cost for FundCruncher, Plus. Includes an unlimited site
license for Corps use. The government does not own the code. $1,798,000.

SOURCE: Average of 5 1999-2000 GSA price lists.

2. Data Interfaces. Includes all work for Corps database interface
capability. 2 programmers @$44,500/yr each x 18.3 months = $136,000.

SOURCE: Taken from an average of 3 contractor estimates: Divine Software
Developers, Technologies, Inc., and Systems-R-Us.

3. System Deployment. Includes all loading, installation, materials, and
hook-up for the Corps and other required points-of-contact. Also requires
extra peripherals. 1000 workstations @ $260/workstation = $260,000.
Deployment will be completed in 12 months.

SOURCE: Taken from an average of 3 contractor estimates: Divine Software
Developers, Technologies, Inc., and Systems-R-Us.

4. Hotline Support. Flat-rate fee for hotline support: No time limit for
calls - installation problems, bugs, etc. Application features covered.

SOURCE: MacroFirm's 1999-2000 GSA price list estimate.

5. Software Maintenance. Estimate number of hours per year is 196. $27/hr x
196 = $5,300.

SOURCE: Taken from an average of 3 contractor estimates: Divine Software
Developers, Technologies, Inc., and Systems-R-Us.

6. Software Upgrades. Upgrades needed to accommodate system expansion.
Scheduled release date 2003. Purchase price = $350,000.

SOURCE: MacroFirm's 1999-2000 GSA price list estimate.

7. Database Maintenance. Includes all trouble-shooting and database
integration. Approx. 480 hrs. @ $25/hr = $12,000 for 1st year. Subsequent
years: 240 hrs. @ $25/hr = $6,000.

SOURCE: Taken from an average of 3 contractor estimates: Divine Software
Developers, Technologies, Inc., and Systems-R-Us.

8. Project Administration. Includes day-to-day administration of the system.
Approx. 300 hours @ $15/hr = $4,500 for the 1st year. Subsequent years: 213
hours @ $15/hr = $3,200.

SOURCE: Taken from an average of 3 contractor estimates: Divine Software
Developers, Technologies, Inc., and Systems-R-Us.

```
        L I F E   C Y C L E   C O S T   R E P O R T        PAGE 013
```

SOURCE AND DERIVATION OF COSTS AND BENEFITS (cont.):

ALTERNATIVE 4: ULTIMA IN C++

1. Software Development. 8 C++ Programmers (@ $118,750,/yr salary) x 14.8 mths = $1,175,000.

2. Data Interfaces. Includes all work for Corps database interface capability. 1 C++ Programmer (@ $42,000/yr salary) x 24 months = $84,000.

3. System Deployment. Includes all loading, installation, materials, and hook-up for the Corps and other required points-of-contact. 1000 workstations @ $150/workstation = $150,000.

4. Hotline Support. Flat-rate fee for limited hotline support: 3 minute max. for calls - installation problems, bugs, etc. Application features not covered.

5. Software Maintenance. Estimated number of hours for maintenance per year is 221. 221 x $27/hr (maint. rate) = $5,980.

6. Software Enhancements. Enhancements must be done to accommodate mandated functionality and Corps system expansion. Some enhancements are needed in deployment year 2000: 1 programmer @ $59,333/yr x 9.2 months = $45,677. Years 2001, 2002: 2 programmers ($59,333/yr each) x 11.6 months = $115,000. Years 2003-2005: 6 programmers ($59,333/yr each) x 11.5 months = $340,000.

7. Database Maintenance. Includes all trouble-shooting and database integration. Approx. 480 hrs. @ $25/hr = $12,000 for 1st year. Subsequent years: 240 hrs. @ $25/hr = $6,000.

8. Project Administration. Includes day-to-day administration of the system. Approx. 300 hours @ $15/hr = $4,500 for the 1st year. Subsequent years: 213 hours @ $15/hr = $3,200.

SOURCE: All Costs and Schedules taken from an average of 3 contractor estimates: Divine Software Developers, Technologies, Inc., and Systems-R-Us.

```
          C O S T   S E N S I T I V I T Y   A N A L Y S I S      PAGE 001


COST SENSITIVITY ANALYSIS NUMBER ............... 01
TITLE ......................................... Ada vs. C++: Ada Software
                                                Enhancements
ALLOWABLE CHANGE .............................. 200.00 PERCENT

This sensitivity analysis checks for alternative  4 to be ranked least cost as
a result of changes in the expense item(s) listed below:

    ALTERNATIVE                 EXPENSE ITEM(S)
    -----------                 ---------------
     2 - ULTIMA in Ada           6 - Software    Enhancements

     4 - ULTIMA in C++          ** NOTHING CHANGED **


The selected expense items are allowed to vary from a value of 100% less than
their input value to 200.00% more than their input value.

    ALTERNATIVE                 NET PRESENT VALUE
    -----------                 -----------------
     2 - ULTIMA in Ada               $2,246,927
     4 - ULTIMA in C++               $2,642,885

For alternative  4 to be ranked least cost, increase the selected expense
item(s) by more than 42.07%.
```

```
            C O S T   S E N S I T I V I T Y   A N A L Y S I S   1      PAGE 002

                 Graph of NPV vs. % change in expense items

          =+=========+=========+=========+=========+=========+=========+=
     4135 -                                                           2-
          I                                                         22 I
          I                                                        2   I
          I                                                      22    I
     3852 -                                                     2      -
          I                                                   22       I
          I                                                  2         I
          I                                                22          I
   A 3569 -                                               2           -
   C      I                                             22            I
   T      I                                            2              I
   U      I                                          22               I
   A 3286 -                                         2                 -
   L      I                                       22                  I
          I                                      2                    I
          I                                    22                     I
   D 3003 -                                   2                       -
   O      I                                 22                        I
   L      I                                2                          I
   L      I                              22                           I
   A 2720 -                             2                             -
   R      I4444444444444444444444444444MM44444444444444444444444444444I
   S      I                           2                               I
          I                         22                                I
     2437 -                        2                                  -
          I                      22                                   I
          I                     2                                     I
          I                   22                                      I
     2154 -                  2                                        -
          I                22                                         I
          I               2                                           I
          I             22                                            I
     1871 -            2                                              -
          I          22                                               I
          I         2                                                 I
          I       22                                                  I
     1588 -      2                                                    -
          I    22                                                     I
          I   2                                                       I
          I 22                                                        I
     1305 -2                                                          -
          =+=========+=========+=========+=========+=========+=========+=
         -100.00    -50.00      .00     50.00    100.00    150.00    200.0
```

                      % CHANGE IN EXPENSE ITEMS

            LEGEND   DESCRIPTION
            ------   -----------
            2   ULTIMA in Ada
            4   ULTIMA in C++
            M   MERGING DATA

```
              C O S T   S E N S I T I V I T Y   A N A L Y S I S      PAGE 003


COST SENSITIVITY ANALYSIS NUMBER ............... 02
TITLE ......................................... Ada vs. COTS: Ada Software
                                                Enhancements
ALLOWABLE CHANGE .............................. 200.00 PERCENT


This sensitivity analysis checks for alternative  3 to be ranked least cost as
a result of changes in the expense item(s) listed below:

     ALTERNATIVE                EXPENSE ITEM(S)
     -----------                ---------------
      2 - ULTIMA in Ada          6 - Software    Enhancements

      3 - Commercial Off-The-S   ** NOTHING CHANGED **


The selected expense items are allowed to vary from a value of 100% less than
their input value to 200.00% more than their input value.

     ALTERNATIVE                NET PRESENT VALUE
     -----------                -----------------
      2 - ULTIMA in Ada              $2,246,927
      3 - Commercial Off-The-S       $2,591,653

For alternative  3 to be ranked least cost, increase the selected expense
item(s) by more than 36.62%.
```

```
              C O S T   S E N S I T I V I T Y   A N A L Y S I S   2     PAGE 004

         Graph of NPV ($ in thousands) vs. % change in expense items


                =+=========+=========+=========+=========+=========+=========+=
          4135 -                                                            2-
               I                                                         22 I
               I                                                        2   I
               I                                                       22   I
          3852 -                                                      2     -
               I                                                    22      I
               I                                                   2        I
               I                                                 22         I
     T    3569 -                                               2           -
     H         I                                             22            I
     O         I                                            2              I
     U         I                                          22               I
     S    3286 -                                        2                  -
     A         I                                      22                   I
     N         I                                     2                     I
     D         I                                   22                      I
     S    3003 -                                 2                         -
               I                               22                          I
               I                              2                            I
     O         I                            22                             I
     F    2720 -                          2                               -
               I                        22                                 I
               I3333333333333333333333333M3333333333333333333333333333333333I
     D         I                      22                                    I
     O    2437 -                    2                                      -
     L         I                  22                                        I
     L         I                 2                                          I
     A         I               22                                          I
     R    2154 -              2                                            -
     S         I            22                                             I
               I           2                                               I
               I         22                                                I
          1871 -        2                                                  -
               I      22                                                   I
               I     2                                                     I
               I   22                                                      I
          1588 -  2                                                        -
               I 22                                                        I
               I 2                                                         I
               I 22                                                        I
          1305 -2                                                          -
                =+=========+=========+=========+=========+=========+=========+=
              -100.00     -50.00      .00      50.00    100.00    150.00    200.0

                        % CHANGE IN EXPENSE ITEMS


                  LEGEND     DESCRIPTION
                  ------     -----------
                  2          ULTIMA in Ada
                  3          Commercial Off-The-S
                  M          MERGING DATA
```
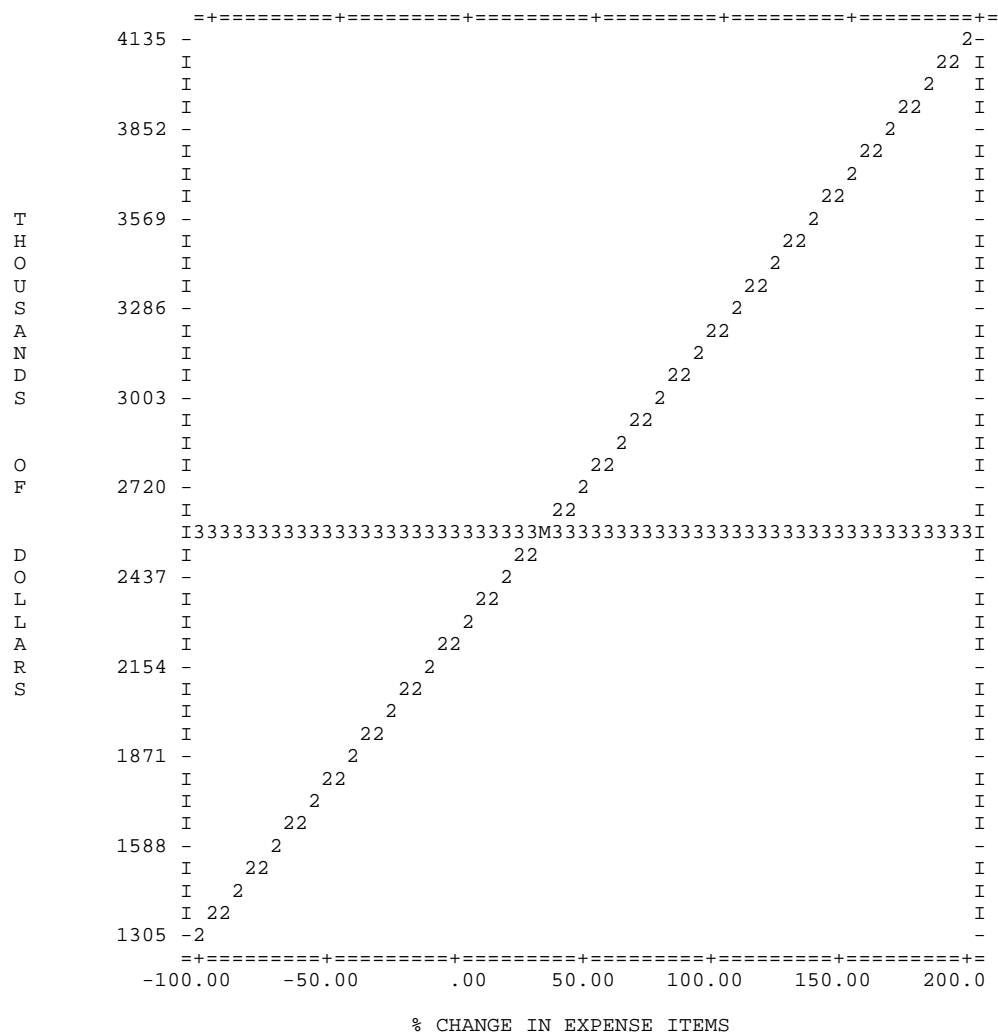
```
   D I S C O U N T   R A T E   S E N S I T I V I T Y   A N A L Y S I S  1    PAGE 001

       Graph of Net Present Value ($ in thousands) vs. Discount Rate


       =+===========+===========+===========+===========+===========+=
  4190 -1111111                                                     -
       I       111111111111111                                      I
       I                       11111111111111                       I
       I                                      111111111111111        I
  3992 -                                                             -
       I                                                             I
       I                                                             I
       I                                                             I
  3794 -                                                             -
       I                                                             I
       I                                                             I
       I                                                             I
  3596 -                                                             -
       I                                                             I
       I                                                             I
       I                                                             I
  3398 -                                                             -
       I                                                             I
       I                                                             I
       I                                                             I
  3200 -                                                             -
       I                                                             I
       I                                                             I
       I                                                             I
  3002 -                                                             -
       I                                                             I
       I                                                             I
       I                                                             I
  2804 -                                                             -
       I                                                             I
       I4444                                                         I
       I    444444444444444444444444444444                          I
  2606 -3333333333333333333333333333333333MMMMMM4444444444444       -
       I                                        3333333333333        I
       I                                                             I
       I                                                             I
  2408 -                                                             -
       I                                                             I
       I                                                             I
       I2222222222222222222222222222222222222                       I
  2210 -                                         2222222222222222    -
       =+===========+===========+===========+===========+===========+=
       1.87        2.17        2.47        2.77        3.07       3.3

                          DISCOUNT RATE (%)

            LEGEND  DESCRIPTION              LEGEND  DESCRIPTION
            ------  -----------              ------  -----------
            1       Status Quo: 70 Diffe     M       MERGING DATA
            2       ULTIMA in Ada
            3       Commercial Off-The-S
            4       ULTIMA in C++
```

D I S C O U N T   R A T E   S E N S I T I V I T Y   A N A L Y S I S   1   PAGE 002

Summary of Alternative Rankings by Discount Rate

Discount Rate: 2.50   Lower Limit: 1.88   Upper Limit: 3.13

```
                    Discount        Alternative
                    Rate (%)        Ranking
                    --------        -----------
                      1.88          2   3   4   1
                      1.98          2   3   4   1
                      2.08          2   3   4   1
                      2.18          2   3   4   1
                      2.28          2   3   4   1
                      2.38          2   3   4   1
                      2.48          2   3   4   1
                      2.50          2   3   4   1
                      2.58          2   3   4   1
                      2.68          2   3   4   1
                      2.78          2   3   4   1
                      2.88          2   3   4   1
                      2.98          2   3   4   1
                      3.13          2   3   4   1
```

* indicates a change in the alternative ranking occurred.

```
       D I S C O U N T   R A T E   S E N S I T I V I T Y   A N A L Y S I S  1    PAGE 003


                    Table of Net Present Value for each Discount Rate

      Discount Rate =  1.88%      Discount Rate =  1.98%      Discount Rate =  2.08%
      Alt - NPV                   Alt - NPV                   Alt - NPV
      --------------------        ---------------------       ---------------------
       2  -      $2,283,552        2  -      $2,277,560        2  -      $2,271,602
       3  -      $2,611,655        3  -      $2,608,397        3  -      $2,605,152
       4  -      $2,686,801        4  -      $2,679,615        4  -      $2,672,470
       1  -      $4,189,681        1  -      $4,175,634        1  -      $4,161,658


      Discount Rate =  2.18%      Discount Rate =  2.28%      Discount Rate =  2.38%
      Alt - NPV                   Alt - NPV                   Alt - NPV
      --------------------        ---------------------       ---------------------
       2  -      $2,265,676        2  -      $2,259,782        2  -      $2,253,920
       3  -      $2,601,918        3  -      $2,598,695        3  -      $2,595,486
       4  -      $2,665,363        4  -      $2,658,297        4  -      $2,651,267
       1  -      $4,147,765        1  -      $4,133,946        1  -      $4,120,202


      Discount Rate =  2.48%      Discount Rate =  2.50%      Discount Rate =  2.58%
      Alt - NPV                   Alt - NPV                   Alt - NPV
      --------------------        ---------------------       ---------------------
       2  -      $2,248,093        2  -      $2,246,927        2  -      $2,242,289
       3  -      $2,592,294        3  -      $2,591,653        3  -      $2,589,107
       4  -      $2,644,283        4  -      $2,642,885        4  -      $2,637,324
       1  -      $4,106,531        1  -      $4,103,806        1  -      $4,092,934


      Discount Rate =  2.68%      Discount Rate =  2.78%      Discount Rate =  2.88%
      Alt - NPV                   Alt - NPV                   Alt - NPV
      --------------------        ---------------------       ---------------------
       2  -      $2,236,522        2  -      $2,230,785        2  -      $2,225,081
       3  -      $2,585,939        3  -      $2,582,778        3  -      $2,579,631
       4  -      $2,630,409        4  -      $2,623,534        4  -      $2,616,693
       1  -      $4,079,414        1  -      $4,065,964        1  -      $4,052,590
```

```
D I S C O U N T   R A T E   S E N S I T I V I T Y   A N A L Y S I S   1    PAGE 004


           Table of Net Present Value for each Discount Rate

 Discount Rate =  2.98%    Discount Rate =  3.13%
 Alt - NPV                 Alt - NPV
 ---------------------     ---------------------
  2  -       $2,219,401     2  -       $2,210,946
  3  -       $2,576,497     3  -       $2,571,820
  4  -       $2,609,891     4  -       $2,599,757
  1  -       $4,039,286     1  -       $4,019,463
```

Glossary

Section I: Abbreviations and Acronyms

ABCR
annual benefit/cost ratio

ABOM
annual benefit/output measure

AIS
Automated Information System

AR
Army Regulation

BA
Budget Analysis

BCR
Benefit/cost ratio

CEAC
Cost and Economic Analysis Center (U.S. Army)

CIM
Corporate Information Management

DA
Department of the Army

DA PAM
Department of the Army Pamphlet --

DOD
Department of Defense

DPP
discounted payback period

EA
Economic Analysis

EPIR
efficiency/productivity increase ratio

ER --
Engineer Regulation --

EUAC
equivalent uniform annual cost

GS
Grade and Step level

GSA
General Services Administration

HQDA
Headquarters, Department of Army

HQUSACE
Headquarters, U.S. Army Corps of Engineers

IDA
Institute for Defense Analysis

IDEF
Integration Definition Method (or Methodology)

ISSC
Information Systems Software Center (U.S. Army)

MAISRC
Major Automated Information System Review Committee

NPV
net present value

OCE
Office of the Chief of Engineers

O & M
operation and maintenance

PMO
Project Manager's Office

SIR
savings/investment ratio

USACE
U.S. Army Corps of Engineers

USAISC
U.S. Army Information Systems Command

Section II: Terms

Alternative
A course of action, means, or methods by which an objective may be achieved.

Assets
Real and personal property and other items of monetary value.

Assumption
A statement describing unknown factors, data and circumstances that may affect the outcome of the analysis. Used to describe the future environment when factual data about the environment are unknown.

Base Year
The reference year for all present value calculations (costs are converted to present value amounts as of the beginning of the base year).

Benefit
Outputs or effectiveness expected to be received or achieved over time as a result of implementing an alternative. These can be quantifiable in terms of dollars, or nonquantifiable, such as intangible effects (increased morale, etc).

Benefit/Cost Ratio
An economic indicator of efficiency defined as the ratio of the value of benefits to costs. When expressed in dollar terms, both the benefit and cost streams are discounted to reflect the present value of future costs and benefits.

Budget Analysis
Type of analysis which documents the costs of a relatively modest systems resource acquisition (Class VI(C)), and is performed when the range of the anticipated program cost is $50,000 to $250,000. In this process, the analyst must consider reasonable solutions to satisfy a problem, then select one for life-cycle costing.

Compound Interest
Interest which is computed on both the original principal and its accrued interest.

Constant Dollars
Estimate in which costs reflect the level of prices of a specified year. Cost estimates expressed in constant dollars imply the purchasing power of the dollar remains unchanged over the analysis period.

Cost/Benefit Analysis
Technique for assessing the range of costs and benefits associated with a certain alternative, usually to determine feasibility. Costs are usually in monetary terms, but benefits need not be.

Cost Element
Basic unit of cost, such as hardware and operations. Related basic units are classified under a cost category (see nonrecurring cost and recurring cost).

Cumulative Net Present Value
The total of the discounted annual cost for the year in question and all preceding years of the project.

Current Dollars
Convention used to show purchasing power in the year spent. Prior costs stated in current dollars are the actual amounts paid out. Future costs stated in current dollars are actual amounts expected to be paid, including increases caused by future price changes (inflation).

Depreciation
A decrease in the value of an asset estimated to have accrued during an accounting period due to age, wear, usage, obsolescence, or the effects of natural elements (decay, corrosion, etc.).

Discount Factor
Multiplier calculated using the present value formula and a discount rate. Used to convert a future cost into its present value.

Discount Rate
Interest rate used to relate present and future dollars. Expressed as a percentage and used to reduce the value of future dollars in relation to present dollars to account for the time value of money.

Discounting
Technique for converting various cash flows occurring over a period of time to equivalent amounts at a common point in time, considering the time value of money, to allow valid comparisons.

Discounting Convention
Method of discounting costs, either at beginning-of-year, middle-of-year, or end-of-year.

Discounted Payback Period (DPP)
Time required for the accumulated present value of savings of a proposed alternative to equal the total present value of

its investment costs.

Economic Analysis
A systematic method for quantifying the costs and benefits of alternative solutions for achieving an objective in order to determine the most economical solution. A structured method to identify, analyze, and compare costs and benefits of the alternatives.

Economic Life
The period of time over which the benefits of the selected alternative are expected to accrue. The economic life of an alternative is often limited by the alternative's physical life (the period of time over which the asset can physically perform) or technological life (the period before the asset becomes technologically obsolete).

Equipment Life
The time during which the equipment of the system is operational without an undue number of repairs and while the vendor continues to provide support.

Equivalent Uniform Annual Cost (EUAC)
The amount of money which, if paid in equal annual installments over the life of a project, would pay for the project. That is, the discounted value of this hypothetical uniform cost stream is equal to the actual estimated present value of project costs. The alternative with the lowest uniform annual equivalent amount is the least costly alternative.

Functional Economic Analysis
See page 5-8.

Historical Cost
Price based on actual monetary outlay, determined after the fact.

Inflation
The rise in costs (or prices) of goods and services over time.

Inherited Asset
An existing asset that will be used in an alternative. If the asset could be used for some other purpose or sold, its value is included as a cost in the alternative. If it has no use or value except in the alternative, no cost is included.

Interest
A price (or rent) charged for the use of money.

Investment Costs

Includes research and development and production and deployment costs of a system. These are usually one-time costs, although they may be spread over more than one year.

Lead Time
The period from the start year to the time that the selected alternative begins to produce benefits, or when the project is complete.

Least-cost Alternative
The alternative that satisfies, at less cost, the same requirements or criteria than another alternative.

Life-cycle cost
The total price of an item over its life cycle. Includes initial investment, maintenance and repair, operations, utilities and, where applicable, disposal.

Net Present Value
The cumulative discounted amount that also includes the discounted value of the residual amount, if any. Equals total discounted costs minus total discounted benefits.

Nonrecurring Cost
Cost that occurs on a one-time basis, as opposed to annual recurring costs.

Objective
The function to be accomplished or the requirement at hand. The objective should be stated in concise, unbiased and, if possible, quantifiable terms.

Opportunity Cost
Amount of money associated with expending capital resources instead of investing them. If funds are expended, the potential that might be gained from investing them is lost.

Output
Products, functions, tasks, services, or capabilities that an organization exists to produce, accomplish, attain, or maintain.

Period of Analysis
The economic life of the selected system alternative plus the lead time, or the period of time from the start year to the end of the economic life.

Physical Life
Estimated number of years that a piece of equipment or building can be physically used in accomplishing the function for which it was procured or constructed.

Present Value
Monetary expenditure (or savings) multiplied by the discount factor. The resulting figure is the worth of the future amount in base year dollars.

Program Costs
Includes all costs incurred from project initiation through full deployment of the system to each operational site. Note how this differs from life cycle costs, which include all costs throughout the entire life cycle of a project.

Project
A major mission-oriented endeavor that fulfills statutory or executive requirements, and that is defined in terms of principal action required to achieve a significant objective.

Real Discount (Interest) Rate
Discount rate with inflation removed.

Recurring Cost
Cost that occurs on a periodic basis, as opposed to one-time, nonrecurring cost.

Replaced Asset
An asset substituted with an alternative. It is made available for other use by the government or is advertised for sale. Its value is subtracted from the NPV of the alternative.

Residual Value
The remaining monetary worth, if any, of an alternative at the end of the period of analysis.

Savings
Reduction in costs achieved without reduction in performance. Always computed with respect to the existing course of action (status quo).

Savings-to-Investment Ratio (SIR)
Ratio of discounted future cost savings to the discounted investment costs necessary to effect those savings. An SIR of 1 indicates that the present value of savings is equal to

the present value of investment.

Sensitivity Analysis
An examination of how the economic analysis results may change with respect to changes in costs timing of costs of an alternative(s). High-cost elements and questionable assumptions should be tested.

Start Year
The first year in which costs occur for the selected alternative. All costs in the budget analysis are estimated to reflect the price level of the start year.

Status Quo
The current method of operations.

Sunk Cost
Cost that occurs before the period of analysis. These costs have no effect on the future and are thus disregarded in the analysis.

Technological Life
The number of years a system or piece of equipment will be used before it becomes obsolete due to changes in technology.

Uncertainty
The state of knowledge about outcomes in a decision which is such that it is not possible to assign probabilities in advance. Doubt or ignorance about the magnitude or timing of costs and benefits.

Wash Cost
A cost that is identical for all alternatives. Omitted from the life-cycle cost analysis and economic analysis because it cannot alter the decision.

Functional Economic Analysis

The Corporate Information Management (CIM) initiative in the Department of Defense has recently established a requirement for functional economic analysis for large automated information systems.

The concept of functional economic analysis is a response to the concern that economic analyses were completed only to receive approval to invest in information systems, and not as an integral part of evaluating the best way to perform a business process.

According to Navy Publication 15, "Functional Economic Analysis Training For Automated Information Systems FEA Submissions", there is a specific way of performing tasks that are unique to a department or functional area. Within a functional area, a person's work can be broken down into distinct activities or job functions, and each of those job functions has a measurable cost, in terms of time, equipment, supplies, etc. Functional economic analysis is the determination and analysis of those functions and associated costs.

The discipline, activity-based costing, allocates these functional costs and can facilitate the accurate measurement of cost and performance associated with a specific activity. The CIM initiative recommends the use of the IDEF modeling methodology for identifying the functions and allocating budgets by cost element across functions performed in a department or business area.

All three concepts -- IDEF methodology, activity-based costing, and functional economic analysis -- are new to most members of the Department of Defense community.

In January 1992, the U.S. Army's Information Systems Software Center (ISSC) and Cost and Economic Analysis Center (CEAC) conducted a joint training program on functional economic analysis. The remainder of this paper outlines the points that were presented at the training program.

There are six basic component of the functional economic analysis concept. They are listed below.

SIX BASIC COMPONENTS OF FEA CONCEPT

1. There is a process of doing business at the functional level. This process can be modeled and costs can be determined.

2. Functional costs can be divided into two general areas. They are Direct and Indirect.

3. Management initiatives can identify alternatives which, when implemented, will reduce the cost of doing business.

4. These potential reductions establish hard savings which can be used to measure the worth of competing alternatives. Hard savings are defined as money that can be permanently removed from an agency's budget.

5. Management initiatives may focus on technology but must also include reducing overhead and eliminating redundancy.

6. Capital investment is normally required to improve business processes, and savings can be tied directly to this expenditure.

Following these six concepts, ISSC and CEAC identified eight essential elements of the FEA process. They are listed below.

```
  EIGHT ESSENTIAL ELEMENTS OF THE
FEA PROCESS

1.    Define the Functional Area.

2.    Model the process and system
      flow.

3.    Gather costs as a by-product
      of the model.
4.    List all feasible alterna-
      tives.

5.    Estimate costs of each fea-
      sible alternative within the
      process model boundaries.

6.    Perform (analytically) the
      functional economic analy-
      sis.

7.    Select the best alternative
      within funding constraints.

8.    Implement and track the ex-
      penditure of funds and the
      accrual of benefits.
```

Note that these eight elements are not significantly different from the seven steps of financial analysis. Key differences are elements two and three which indicate the emphasis on modeling. In addition, element eight includes the follow-up after the alternative has been selected and implemented, whereas financial analysis ends with the selection. The distinction is that these essential elements focus on the process of which FEA is one element.

The concepts of functional economic analysis and business process are new to the Department of Defense and are untested. The representatives of ISSC and CEAC cautioned persons at the training session that implementing these new concepts will take time. In addition, the format of functional economic analysis has its emphasis on direct versus indirect costs and there is a lack of audit trails. This does not con-

form to the current requirements set by the Department of Defense's Major Automated Information System Review Council (MAISRC). The trainers presented eight points of caution for the attending persons. They are listed below.

```
      FEA's - REALITY FOR 1992

1.    This is a pioneering effort
      and very few examples are
      available to use as bench-
      marks.

2.    An FEA could take twice as
      long as an economic analy-
      sis.

3.    There are short term
      requirements to support
      future expenditures.

4.    There is only a generalized
      format and the cost cells
      are unique.

5.    Overhead must be costed, and
      this was never done before.

6.    In the short term, the FEA's
      are a restatement of
      validated EA data into a new
      generic format.

7.    Functional Areas are not
      neatly divided and overlap.

8.    FEA's do not currently
      support the
    MAISRC process.
```

The currently accepted FEA computer software model is the Institute for Defense Analysis (IDA) model. Information on it can be acquired by contacting:

  Institute for Defense Analysis
  1801 N. Beauregard Street
  Alexandria, VA 22311
  (703)845-6780